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NOTES AND COMMENTS

International Sugar Conference.

The Conference was opened in Geneva on the 22nd September by Mr. G. PALTHEY, Deputy Director of the European Office of the United Nations. The Executive Director of the International Sugar Council, Mr. ERIC ROLL, was unanimously elected Chairman of the Conference and Dr. A. MAÑAS and Mr. A. M. THOMAS of Cuba and India, respectively, as 1st and 2nd Vice-Chairmen. The Conference includes representatives of 43 countries, with observers from 5 others and various World Organizations.

Japan asked that the voting procedure should be amended to allow balancing of importers and exporters votes since exporting countries were always in a majority. Ireland applied for membership of the Agreement. While it is to be hoped that Brazil and Peru will accede to the new agreement, the Philippines delegate pointed out that his country's mills were running under capacity, and, should excessive quotas be offered to new countries as an inducement to join, the Philippines might withdraw since sugar exports were vital to her economy.

Messrs. F. O. LICHT, K.G. have published a special number on the occasion of the Conference which is printed in two languages—German and English—and is in three parts. The first describes the history of attempts to control the sugar economy of the world by international agreement and then discusses the achievements of the Agreement of 1953. It concludes that it certainly protected the interests of the sugar producing countries, but its provisions were not adequate to protect the consumer from the repercussions of political events, particularly the Suez crisis. It goes on to discuss the difficulties facing the negotiators at Geneva in view of the likelihood of demands for quotas which will exceed the outlets available—the rock on which the Chadbourne agreement foundered. It is emphasized that the non-member countries are expected to supply no less than 28·8% of free market requirements in 1958 and consequently, on the one hand, the Council cannot comply with high quota demands and, on the other, the non-members are able to undermine the Agreement, leading to a breakdown of sugar prices which would be harmful to the producers and, in the long run, to the importers.

Suggestions include a large emergency reserve which would protect the importers and also a system of partial allotments as protection against severe decreases in sugar prices. Flexibility in the Agreement should be maintained, while prohibition of imports of non-member sugar by member countries is condemned. The minimum price, it is argued, should be raised to allow for increased production and general costs, but not too far. For better likelihood of accuracy in forecasting production and consumption, a return from the calendar year basis to the September–August crop year basis as chosen in 1937 (or better, October—September) is recommended.

The second section contains statistics of world sugar production and balance, and free market imports and exports, while the third is a review of developments in sugar consumption throughout the world together with a forecast of future demands.

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European Crop Estimates.

Licht's first estimates of the European sugar production for the current season have been published and appear on page 343 of this issue. C. Czarnikow Ltd.[1] comment "Although a record outturn was achieved in 1957/58 it was thought that some improvement would be registered this year in view of the expansion in the area devoted to the crop. Nevertheless, there can be few who would have anticipated Licht's figure of 17,421,700 metric tons, some 1.5 million tons above his estimate of last year's outturn.

"By far the largest increase is looked for in Russia, where production is estimated at 5,850,000 tons, against 4,900,000 tons last season. In a country where production is so large, but from which so few statistics are forthcoming, it is difficult to formulate any estimates, but Licht points out that generally excellent growing conditions were experienced, which prompted the Soviet authorities to announce that the tonnage of roots will be in excess of last season's figure by some five to six million tons.

"Elsewhere in Eastern Europe the forecasts of most interest are in respect of East Germany and

[1] *Sugar Review*, 1958 (375), 171.

Czechoslovakia, in both of which countries production is put at 800,000 tons. These figures appear to be based on the areas sown, which also correspond. The reductions against last year's figures are 52,000 tons and 80,000 tons, for East Germany and Czechoslovakia respectively.

"Western European figures are mostly higher than last year's, in some cases considerably so. Western Germany, France, Holland, Italy and Spain are all put at least 100,000 tons above the 1957/58 production. reflecting the larger areas sown to beet. In the case of the last named country growing conditions have been particularly poor this year, drought during much of the season and also damage by pests having caused growers much anxiety. It is interesting, therefore, if a little surprising, that Licht has seen fit to match the fifty per cent increase in area with a corresponding increase in the production estimate. On the other hand it is considered by some that the Dutch estimate will eventually have to be increased.

"The small increase forecast in respect of Great Britain is not unreasonable in view of the current beet tests, but the estimate in respect of the Irish Republic may well prove to be somewhat over-optimistic. The campaign will not commence in that country until about mid-October and this late start seems likely to make it necessary eventually to reduce the current estimate of 145,000 metric tons.

"In Turkey the crop has suffered from very bad growing conditions this year. Nevertheless, despite the smaller area, Licht looks for a slight increase in the sugar outturn. In this view he is not alone and according to some well-informed circles, his figure may even prove eventually to be on the low side.

"The only countries in Western Europe in which important reductions against last season's figures are looked for are Sweden and Jugoslavia, both of which have reduced the area devoted to the crop and have also received unfavourable weather conditions. The Swedish estimate is down on the 1957/58 outturn by 67,000 tons, whilst for Jugoslavia production is put at 196,000 tons against 261,000 tons."

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International Sugar Agreement—Export Quotas, 1958.

On 28th November 1957 the International Sugar Council fixed at 100% of basic export tonnages the initial export quotas of participating exporting countries for the quota year 1958. Since that date the following surrenders have been made under Article 11 of the Agreement :

	Date of Surrender	*Amount Surrendered*
Kingdom of the Netherlands	11th January	40,000 tons
France	22nd April	20,000 ,,
Haiti	30th June	43,600 ,,
	24th July	1,400 ,,
U.S.S.R.	22nd August	20,000 ,,
Indonesia	10th September	300,000 ,,

As the result of the redistribution under Article 19, export quotas in effect are now as follows :

Countries with Basic Export Tonnages	*Revised Export Quotas in Effect* (metric tons, raw value)
Belgium	62,398
China (Taiwan)	743,102*
Cuba	2,789,834
Czechoslovakia	301,319
Dominican Republic	743,102
France	—
Haiti	—
Hungary	50,157
Indonesia	50,000*
Mexico	85,088
Kingdom of the Netherlands	—
Philippines	25,000*
Poland	220,000
U.S.S.R.	—
	5,070,000

* These figures do not include the amount allocated as Special Reserve under Article 14A bis.

Export quotas of the following countries include amounts allocated as a result of the redistribution of the Indonesian surrenders :

Belgium	4,470
China (Taiwan)	53,236
Cuba	196,281
Dominican Republic	53,236
Mexico	6,096

The quotas of these countries now appearing in paragraph 3 are, therefore, provisional as far as the inclusion of the above amount is concerned until a notification of acceptance of the additional allocation is received by the Council.

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N.V. Handelsvereeniging "Amsterdam", 1957 Report.

Indonesia.—Ngadiredjo, Djatiroto and Semboro sugar estates were in operation during the period producing 83,000 tons of sugar compared with 77,600 tons in 1956.

The 1956–1957 monsoon season was inconsistant, but not unfavourable. Partly as a result of still further improved tillage, cane production on the three estates reached a satisfactory level, so that on the whole a good crop was obtained, taking into account post-war conditions.

The area under sugar cane in 1957/1958 totalled 16,500 acres. The latest available estimate for the 1958 crop amounts to about 80,400 tons.

Ethiopia.—The production obtained at Wonji sugar estate in the 1956/57 campaign was 26,050 tons as compared with 16,170 tons in 1955/56.

The extension of the mill to final capacity was completed in time for the 1957/58 campaign, which is going according to plan. Taking into consideration the quantity so far produced it may be assumed that the yield will amount to at least 30,000 tons.

The plans to build a second sugar mill have reached an advanced stage of preparation. It will be decided in the course of the coming months whether or not these plans are to be put into execution before the end of this year. It is still the Company's intention to provide for this new investment by internal financing.

THE SUGAR CANE IN TAIWAN

EXPERIMENT STATION REPORT, 1957

THE Report takes the form of a series of papers some of which are concerned with the following cane cultural matters.

The possibility that yield might depend on the even distribution of a number of tillers was tested by repressing the mother-shoot and "stool-spreading," i.e., the even distribution of the tillers by tramping earth between them. The widely-held belief that such an advantage would result was disproved and, in fact, there was evidence of yield reduction.

Various methods of utilizing bagasse in the field at rates up to 60 metric tons/hectare have been tried out during the 1952–53 to 1956–57 seasons. Ploughing-in, using oxen and, therefore, rather shallow, led to a decreased yield of the cane crop following green manure (*Crotalaria*). Used as a mulch, bagasse increased yields, though those of the ratoons were not significantly affected.

Preliminary field trials with soil fumigants showed some remarkable yields as the result of treatment; in the case of "Ortho-fume 85" the increase was as much as 350%. Pot experiments showed comparable results with the addition that heat sterilization appeared even superior.

With the above may be read the article on the methods recommended for reclaiming salted alluvial soils[1]. Ten methods are cited; they include drainage, deep ploughing, planting of *Sesbania*, application of organic matter and the planting of paddy followed by sugar cane. The responses normal to dressings of gypsum did not occur.

Of the two papers which deal with breeding technique, one records the effect of day-length control combined with increased night temperature on arrowing. Of six varieties which had never arrowed and one which had arrowed only sparingly, three were induced to arrow by a daily shortening of the light period by one minute, two being stimulated by a constant 12 hr day. Raising night temperature appeared to increase the stimulating effect. All flowers were normal, with fertile pollen.

The second paper deals with the bunch method of planting seedlings. Five varieties of different vigour, of which N : Co 310 was the most vigorous, were planted singly, in randomized plots, and in groups containing one seedling of each variety. Yields of the varieties were parallel in both bunch-planted and individual plots, indicating that the former method may be used in cane breeding work.

Downy mildew (*Sclerospora sacchari*) was first identified in 1909 as present in Taiwan, but became of importance only when the then-grown resistant varieties POJ 2725 and F 108 became replaced by the susceptible variety F 134 and P.T. 43-52. An extensive varietal resistance trial is recorded; it covers two seasons and has enabled a number of resistant varieties to be identified. N : Co 310 is one of these and as it occupies over 90% of the cane area, the disease is, for the present, under control.

H. M.-L.

[1] *Taiwan Sugar*, 1958, **5**, (4), 20–22.

AGRICULTURAL ABSTRACTS

"Trash Farming" in Kenya. J. McKILLOP. *Mother Earth*, 1958, **10**, 233–238.—On the Sotik Estate in Kenya a system based on FAULKNER'S *Ploughman's Folly* has been introduced successfully. The "trash" here is maize stalks followed by a catch crop of sunflower. The organic matter is superficially disced in and the land is sub-soiled to shatter the underlying pan.

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Sugar Cane Breeding at Canal Point, Florida, during 1957. P. H. DUNCKELMAN *et al. Sugar Bull.*, 1958, **36**, 240–250.—The various crosses, calculated to produce over 700,000 viable seed, are listed according to the area and purpose (Louisiana, Florida and syrup area) for which the seedlings are ultimately intended to meet the needs. The reasons for their selection are also briefly noted. Particularly adverse weather failed to mar a successful breeding season owing to the shift to indoor breeding. The change has necessitated modification of technique by methods which include air-layering with polythene film and sphagnum moss.

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Some Further Considerations on the Diagnosis of Sugar Cane Nutritional Deficencies under Jamaican Conditions. R. F. INNES *et al. Jamaican Assoc. Sugar Tech. J.*, 1956, **19**, 1–12.—Crop "logging" has proved a valuable asset in determining manurial requirements and is based on the assumption that the plant itself is the best indicator of its well-being. Concordance has not been reached, however, on what constitutes the best measure of that well-being; the main reason is that nutritional relationships within the plant are dynamic. The paper records the results of analyses of material drawn from a factorial experiment with three levels each of N, P and K. Correlations are worked out from the data expressing the significance of the respective tissue analyses at different ages with yield of sugar per acre.

IMPROVEMENT IN THE WORLD NITROGEN POSITION

By Professor N. R. DHAR, D.Sc., F.R.I.C.,
Foreign Associate Academy of Agriculture, France.

IN the sugar industry the yield of sugar per acre is of paramount importance. On page 154 of his book, "Agriculture of the Sugar Cane" (1953), A. C. BARNES has stated that a cane crop of 50 tons removes from the soil 65 lb of nitrogen. Hence an adequate supply of nitrogenous compounds to the soil is of vital concern to the sugar industry. *Nature*,[1] reporting on the meeting of the British Association of 1949, stated :—" At present only some 3% of the world food production can be attributed to the use of nitrogenous fertilizers. To raise the food by 10%, that is to say, one hundred million tons, involves a four-fold increase in supplies of fixed nitrogen at an approximate capital cost of £1,500,000,000. This would take a minimum of 15 years to achieve".

In 1938, 3·54 million tons of nitrogen were produced by the chemical industry of the world and the amounts of nitrogen applied by some industrially advanced nations ranged from 22·2 kg/ha (Belgium) to 0·12 kg/ha (Hungary). In the East, where the majority of the world's population subsists, artificial fertilizers were practically unknown except in Japan and Taiwan. The post-war increase ranges from 85·9 (Iceland) to 4·2 (U.S.A.) kg per ha cultivated. The average of the O.E.E.C. area is 16·8 kg per ha. Corresponding figures for East European and Eastern countries, excluding Japan (109·6), Taiwan (54·1) and Korea (54·1), range from 18·4 (Ceylon) to 0·3 (Pakistan).

The world production and consumption of fertilizers in 1955-56 were as follows :—

TABLE I.

Production (1,000 tons)

Region	N	P_2O_5	K_2O
Western Europe	2,774·8	3,352·0	3,055·9
U.S.A.	2,033·0	2,252·0	1,735·0
Eastern Europe	1,222·7	1,341·8	2,113·0
Far East	843·2	402·1	—
Elsewhere	513·9	1,096·5	12·1
World Total	7,387·6	8,444·4	6,916·0

Consumption (1,000 tons)

Region	N	P_2O_5	K_2O
Western Europe	2,248·9	3,112·9	2,639·9
U.S.A.	1,714·4	1,989·3	1,677·1
Eastern Europe	1,263·8	1,405·9	1,502·4
Far East	1,145·0	411·9	428·3
Elsewhere	591·2	1,230·2	422·3
World Total	6,969·3	8,150·2	6,670·0

It has been estimated that 4000 million acres of land are available for cultivation in the world and of this only 1000 million acres considered first class. Consequently, if the fertilizers consumed in the world are evenly applied to the 4000 million acres, each would receive 3·5 lb N., 4·05 lb P_2O_5 and 3·3 lb K_2O per annum. It is an interesting coincidence that the fertilizers consumed per acre in the U.S.A. in 1956-57 were of this order, that is, 4·2 lb N., 4·6 lb P_2O_5 and 4·0 lb K_2O. These amounts are certainly inadequate for intensive cultivation.

Moreover, the industrially backward countries find it difficult to construct nitrogen factories, as shown by the high capital investment in the different types of ammonia synthesis plants for producing 100 tons of ammonia per day :—

Capital investment in thousands of dollars

Natural gas	Fuel oil	Coal	Coke oven gas	Catalytic reformer gas
3950	4098	4248	3620	2980

In their " Observations on the Planned Provision of Nitrogen Fertilizer," Professor TINBERGEN and others of the Netherlands Economic Institute, Rotterdam, conclude that the consumption of nitrogen per acre is directly proportional to the population density of the country. With the exception of the few countries mentioned above, the nitrogen supplied to crops as fertilizers is low. Only small countries having a high density of population are compelled to use great amounts of chemical nitrogen, but not enough phosphates, for producing cereals to meet their caloric demand. The following lines " As world nitrogen production is outstripping the expansion of demand for traditional purposes (particularly for nitrogenous fertilizer) all producers are looking round for new outlets,"[2] suggest that, due to the high cost of nitrogenous fertilizers, farmers find it uneconomic to use the optimal amounts of nitrogen for crop production. This view-point is supported by the low consumption figures in several European countries and the U.S.A.

World food production is estimated to be 1100 million tons for feeding the 2700 million human beings in the world, with an average nitrogen content of 2%. As only 25% of the added nitrogenous fertilizers and manures is normally recovered in crop yields, approximately 100 million tons of fixed nitrogen seem to be necessary for the world production of food. But, as stated, the chemical industry can provide only some 7 million tons.

Let us now explore the other nitrogen sources for food production. It has been reported that in the U.S.A. 2 million, and in the whole world 5 million,

[1] 1949, **164**, 597.
[2] *Industrial Uses of Nitrogen*, European Productivity Agency of the O.E.E.C., 1957.

tons of nitrogen are fixed by legumes in the soils of the earth. Precipitation, that is, rain and snow, also forms a valuable source of available nitrogen for plants and it has been observed that, in Allahabad (India), rain-water brings down on an average 8 lb per acre of ammoniacal and nitric nitrogen annually. The amounts of nitric nitrogen in tropical regions are larger than the ammoniacal nitrogen due to the photo-oxidation of air ammonia to nitrate. Industrial centres, too, due to burning of coal, have more nitrogen in rain and snow than non-industrial areas. Thus the average annual amount of available nitrogen in rain and snow of all industrial centres in temperate parts is 10 lb per acre, whilst the average from 22 non-industrial regions is only 4 lb. On the basis of present knowledge, the amounts of ammoniacal and nitric nitrogen falling on the 4,000 million acres of agricultural land in the world are of the order of 10 to 12 million tons but a good deal is carried in the run-off and is not beneficial to crops.

According to the U.S. Department of Agriculture, the world produces 1400 million tons of manure containing approximately 7 to 8 million tons of nitrogen but only 15% of this manure is actually utilized in cultivation.

All over the world there is a serious attempt to prepare composts from municipal refuse and sewage sludge. Also, by anaerobic decomposition, methane gas is being obtained in France, Algeria and in a few corporations of the U.S.A. VAN VUREN, on page 29 of his book, " Soil Fertility and Sewage," (1949) has stated : " Fully 90% of all products that originate from land find their way into urban areas ... of which 25 to 50% appear in the end in the form of waste organic matter and is almost entirely lost to land." Assuming that the food and fibre production of the world is 1250 million tons per annum with an average nitrogen content of about 2%, and, even if 25% is wasted, the quality of nitrogen in the waste matter is of the order of 5 to 6 million tons, or practically the amount supplied to world crops as nitrogenous fertilizers. History is repeating itself. Over a century ago, Baron VON LIEBIG, in his " Familiar Letters on Chemistry," ascribed the fall of the Roman Empire to the loss of nitrogenous compounds in the sewers of the capital.

Some 650 million tons of cereals are being produced in the world and hence the output of cereal straw is of the order of 1100 million tons and the straw is likely to contain 7 to 8 million tons of nitrogen.

Since 1935, N. R. DHAR and co-workers[3] have shown experimentally that organic substances such as molasses, cane sugar, glucose, farmyard manure, cereal straw, leaves, grasses, municipal wastes, etc., undergo slow oxidation in air when mixed with soil. In these slow oxidations, energy is liberated as in the following equation with glucose : $C_6H_{12}O_6 + 6O_2 = 6CO_2 + 6H_2O + 676$ Cal. The energy liberated is utilized in fixing the nitrogen of the air on the soil surface, forming ammonia, amino-acids etc.; thus, with the decrease in the amounts of carbonaceous compounds, there is an increase of total nitrogen in the soil. When these systems are illuminated by sunlight or artificial light, the radiation energy is partially absorbed and is actually utilized in increasing the nitrogen fixation taking place in the systems. In all cases, therefore, nitrogen fixation is much greater in light than in the dark, although the numbers of *Azotobacter*, total bacteria and fungi are always smaller in light than in the dark.

In the presence of calcium phosphates, rock phosphates and basic slag, the fixation of atmospheric nitrogen is considerably increased and hence the efficiency of this type of natural nitrogen fixation in presence of sunlight and calcium phosphates is much greater than the efficiency of the industrial methods of fixing nitrogen.[4] This nitrogen fixation on soil surfaces by the oxidation of organic carbon compounds produced by photosynthesis aided by sunlight is the chief source of world soil nitrogen. A time interval of 2-5 months, depending on the soil temperature and nature of the organic matter incorporated in the soil, is necessary between the ploughing in of the organic matter and the sowing of a crop. Consequently, for improving soil fertility and humus, it is useful to incorporate with the soil cattle manure, straw, leaves, molasses, bagasse, legumes, grass sods, green manures, municipal wastes, etc., mixed with basic slag or rock phosphates. Increased supplies of available nitrogen, phosphate, potash and trace elements become available and the soil physical properties are improved.

In composting plant and animal materials, basic slag, rock phosphates, or super-phosphate should always be added, since calcium phosphate in composting can fix atmospheric nitrogen more in sunlight than in darkness. The total nitrogen content of such phosphated composts varies from 1·6 to 2·4%, whilst ordinary HOWARD composts show a nitrogen content of 0·5 to 1%. The classical Rothamsted experiments indicate clearly that the total nitrogen content of soil rose from 0·12 to 0·275% when 200 lb of nitrogen as 14 tons of farmyard manure were added yearly and wheat grown, whilst, by applying 86 to 129 lb of nitrogen per acre as sodium nitrate or ammonium sulphate annually and growing wheat, there was a slow deterioration. It seems that manure fixes atmospheric nitrogen as in our experiments and enriches the soil, but the nitrate added or produced from the ammonium salt, being an oxidizing agent, reacts with the reducing substance, humus, present in the soil and causes soil deterioration. Recently Sir JOHN RUSSELL has stated that food production in the United Kingdom has increased but the cost has been colossal. Greater utilization of organic substances such as cattle manure, straw which is abundant and un-utilized in modern agriculture, green manures, grass sod, municipal wastes, legumes,

[3] Presidential Address to the National Academy of Sciences, India, 1935.

[4] For detailed discussion of this phosphate-light abiotic fixation of nitrogen see :—" The Value of Calcium Phosphate in Atmospheric N Fixation, Soil Fertility and Crop Production." N. R. DHAR, *Kungl. Lantbruk. Annal.*, 1954, **21**, 49–79.

etc., mixed with basic slags, rock phosphates, etc., can meet the shortage of artificial fertilizers, lead to increase of soil humus and cause permanent fertility improvement at a small cost.

In many of our experiments with straw as energy material mixed with good soil rich in calcium phosphate, a nitrogen fixation of 150 mg per g of carbon oxidized has been observed in sunlight and 78 mg in the dark. Botanists have estimated that about 13,750 million tons of organic carbon are added to the earth annually by photo-synthesis as cellulose. Assuming that only 40% of this organic carbon is oxidized in a year on the soil surface and there is a nitrogen fixation of 20 mg per g of carbon oxidized, the amount of nitrogen fixed on the surface of the world soils would be approximately 110 million tons per annum, half of which may be caused by sunlight absorption. It is gratifying to record that Mr. G. BJÄLFVE of the Royal College of Agriculture of Sweden has completely verified the marked nitrogen increase in soils by photo-chemical fixation of nitrogen even under the climatic conditions of Sweden.

AGRICULTURAL ABSTRACTS

The Effect of New Varieties on the Juice Quality and Yield. P. L. CARRINGTON, *Jamaican Assoc. Sugar Tech. J.*, 1956, **19**, 13–16.—The conditions covered are those of the alkaline soils of the Shrewbury section of the West Indies Sugar Co. Ltd. Between 1947 and 1951 the acreage under B 34104 increased with a corresponding decrease in juice quality. Subsequently new varieties, B 41227, B 42231 and B 4362, have come to occupy 66% of the area and the juice quality has risen from below to above average for the Frome Division.

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An Evaluation of Aqueous Ammonia as a Source of Nitrogen for Sugar Cane in Jamaica. R. F. INNES *et al. Jamaican Assoc. Sugar Tech. J.*, 1956, **19**, 16–29.—The nature and extent of the loss of ammonia when applied to the soil in aqueous form are discussed. The losses are greater on highly calcareous soils but this is also the case with sulphate of ammonia. However, when aqueous ammonia is injected to 6 inches deep down tractor-drawn tines, its effectiveness (yield cane per acre) is only some 70% that of sulphate of ammonia: a result attributed to ineffective sealing of the tine cuts.

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Review of the Variety Situation in Jamaica. C. E. M. SMITH. *Jamaican Assoc. Sugar Tech. J.*, 1956, **19**, 32–39.—The annual variations in acreage, both total and planted, are given for the years 1952–1956. The main features are: the cessation of planting B34104 and the near cessation of B37161. In their place are: B 41227, especially on the West Coast and in irrigated areas (39% of total 1956 planted area), B 42231, in irrigated areas and, to a lesser extent, in the Central area (18% of the total 1956 planted area), and B 4362 particularly in the Central and East areas, in both of which it is now the dominant variety (27% of the total 1956 planted area). The superiority of B 41227 and B 4362 becomes clear from their figures for cwt-sugar/acre/month 7.10 and 7.07 respectively against the island's average of 6.49 to which B 42231 at 5·52 approximates. Brief references are also given to the results with latter varieties in lattice experiments and to incidence of disease.

Experience in Martinique on Payment for Cane on the Basis of Juice Quality. H. HAYOT. *Rev. Agric. Sucr. Rhum. Antilles Franç.*, 1957, **2**, 167–175.—The problem of devising a system of payment for cane which takes into account quality, when a host of small cultivators is involved, has never found a ready solution. The Hugot system[1] has been tested in Martinique and it is hoped to introduce it gradually over a period.

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Effect of Lime and Phosphate-bearing Materials on Sugar Cane Yields. J. A. BONNET *et al. J. Agric.*, (Univ. Puerto Rico), 1958, **17**, (1,) 1–6.—Data on field experiments with sugar cane on acid clay soils in the humid area of Puerto Rico at the Corozal Agricultural Experiment Substation are given. The effect of lime and of superphosphate and hyperphosphate were tested, one plant crop and two succeeding ratoon crops being used. No significant difference resulted from phosphatic fertilizer used alone on the acid soil. Lime caused significant increases amounting to 11·3 tons of sugar cane per acre. The highest increase (24·3 tons) resulted from lime plus 200 lb P_2O_5 per acre as superphosphate.

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History of the Sugar Cane Industry in Peru. S. ECHEANDIA CAULONS. *Azúcar*, 1957, **4**, (12), 3–18.—The early history from the introduction of sugar cane to Peru between 1535 and 1540 is dealt with briefly. Since 1914, production, as the result of increased area and increased yield per ha, has expanded by 500%. Though internal consumption has increased manifold (33,072 metric tons in 1914 to 239,013 metric tons in 1956) the increase in total production from 228,055 to 717,773 tons during the same period still leaves the external market of dominant influence in the industry. The article discusses this aspect and the position the industry occupies in the country's economy.

[1] *I.S.J.*, 1955, **57**, 187-190.

Biological Control of the Cane Borer. SAUL H. RISCO. *Azúcar*, 1957, **4**, (12), 19–34.—The results obtained on a number of estates are given in some detail. Of the three parasites liberated, *Paratheresia claripalpis*, *Lixophaga diatraeae* and *Metagonistylum minense*, the first has proved outstanding.

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A General Account of Cane Cultivation in the Cauca Valley, Colombia. J. CÉSAR MÁRQUEZ. *Azúcar*, 1957, **4**, (12), 35–40.—The account covers the economic aspects of, and the cultural systems adopted in, the Cauca Valley.

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Preliminary Observations on *Elasmopalpus lignosellus* in the French Antilles. R. BÉNARD. *Rev. Agric. Sucr. Rhum. Antilles Franç.*, 1958, **3**, 3–4.—Owing to the similarity of the damage done by *E. lignosellus* to that of *D. saccharalis*, the existence of this pest in the French Antilles has been overlooked. The life history is here described together with notes on methods of combating the pest. Two natural parasites have been discovered and the eggs are readily parasitized by *Trichogramma minutum*.

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Correlation between Arrowing, the Hardness of the Stem, Resistance to Wind and Borer Attack. H. STEHLÉ. *Rev. Agric. Sucr. Rhum. Antilles Franç.*, 1958, **3**, 31–38.—Data on such correlations from various countries together with local data on the relative intensity of borer attack are briefly given.

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The Development of Juice Quality of Different Varieties as a Function of Time. H. HAYOT. *Rev. Agric. Sucr. Rhum. Antilles Franç.*, 1958, **3**, 39–48.—The attempt to introduce a system of payment for cane to include quality necessitates a knowledge of how the time factor influences quality if harvesting is to secure maximum financial return to the grower. Here this development is traced for a number of varieties at two centres by analyses conducted at 15-day intervals between 1st March and 6th June.

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Stimulation of Arrowing in the Sugar Cane in the French Antilles. H. STEHLÉ. *Rev. Agric. Sucr. Rhum. Antilles Franç.*, 1958, **3**, 49–57.—The stimulants here considered are : flooding, specific chemicals, insolation and photoperiodism, and border effects.

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Foliar Application of 2,4-D to Improve Juice Quality. E. FRETAY. *Rev. Agric. Sucr. Rhum. Antilles Franç.*, 1958, **3**, 69–74.—The results of 20 tests taken from 4 to 14 days after treatments at 60 and 120 p.p.m. are tabulated for tops, middles and bases. Though the figures vary considerably, they are, on the whole, promising and justify further trials.

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On Quantities of Potash Fertilizer. F. T. TABAYOYONG and F. A. BASILA. *Victorias Milling Co., Expt. Sta. Release*, 1958, (18), 6 pp.—On two potash-deficient soils dressings of 150 and 200 kg/ha showed significant increases of sugar per ha, but not of cane in the plant crop.

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Sugar Cane Fertilization according to Soil Type. F. T. TABAYOYONG. *Victorias Milling Co., Expt. Sta. Release*, 1958, (19), 18 pp.—A review is given of the fertilizer experiments carried out, 1952–57, and recommendations are given as to the appropriate fertilizer programme for the various soil types.

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The Problem of Direct Delivery to the Mills. W. R. B. SOMMERVILLE and J. ARDINGTON. *S. African Sugar J.*, 1958, **42**, 461–467. The ox-waggon was replaced by tram lines as a means of delivering cane. The wheel is turning a full circle with a tendency to direct delivery from field to factory. The means are dual : heavy motor combinations carrying up to 28 tons and tractor-trailer units. It is the important features of the latter which are here described by the authors representing the Zululand Cane Mechanization Committee.

* * *

Cytological Studies in *Saccharum* and allied genera II. Geographic distribution and chromosome numbers in *S. robustum*. S. PRICE. *Cytologia*, (Tokyo) 1957, **22**, 40–52; through *Plant Breeding Abstracts*, 1958, **28**, 3236.—From an examination of 130 clones, the author concludes that *S. robustum* is represented by two basic cytological types, with $2n = 60$ and 80 respectively. Forms with these chromosome numbers are not only numerically preponderant but meiotically regular. Aneuploids, probable hybrids and suspected hybrid derivatives also occur, with chromosome numbers ranging from $2n = 63$ to 194. The 60-chromosome types are found in Borneo, Celebes and Australian New Guinea, the 80-chromosome types in Dutch and Australian New Guinea, New Britain and the New Hebrides. The following counts were also made in related species occuring in the geographical range of *S. robustum* : $2n = 96$ in *S. spontaneum* from Celebes, and $2n = 80$ in *S. spontaneum*, $2n = 60$ in *Erianthus arundinaceus* and $2n = 38$ in *Miscanthus floridulus* from New Guinea.

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THE SOLUBILITY OF SUCROSE

By F. H. C. KELLY

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Introduction

THE findings of YOUNG and JONES[1] in identifying hydrates of sucrose with melting points above 0°C and solubilities differing from the solubility of anhydrous sucrose are deserving of consideration from the point of view of the generally accepted solubility relationship of this compound.

Two hydrates were specifically identified by these workers, viz. a hemi-pentahydrate with a melting point of +45·7°C and a hemi-heptahydrate with m.p. approximately +27·8°C. Although a substantial measure of instability was recorded for these compounds and also difficulties by way of initial crystallization, it should not be unreasonable to expect that precision study of the behaviour of sucrose in solution at temperatures below 46°C might reveal a latent influence of the hydrates.

The author[2] recently drew attention to substantial divergence in values recorded in the literature for the solubility of sucrose with greatest agreement round a temperature of 50°C and increasing divergence as conditions departed above or below this value.

The divergences over the higher temperature range may be explained quite plausibly by differing effects on the thermal decomposition of sucrose resulting from differences in the time during which it is held at the specified temperature. WISE and NICHOLSON[3] specifically endeavoured to overcome this objection by employing the technique of DAUNCEY and STILL[4] in which a change in direction of a beam of reflected light coincides with the saturation temperature of the solution.

Such an explanation does not suit observations at lower temperatures when divergences between results of different workers reach as much as 0.8% at 20°C. One difficult factor under all conditions of temperature is the analytical one which, when employing conventional polarimetric or refractometric techniques, hardly justifies the expression of results with a second decimal place. However, analytical data determined by these methods might reasonably be expected to be most reliable at 20°C.

Solubility differences of the magnitude mentioned may, for many purposes, be of little importance, but they are very important for the study of rates of crystallization. Small differences in solubility are substantially magnified when considering the degree of oversaturation of a crystallizing solution.

The author therefore set out to make solubility determinations over the temperature range 0–100°C with a target precision of ±0·01% of concentration. Actually the precision obtained for each temperature studied averaged about ±0·03%.

Controlling Factors

It was decided to employ techniques which involved conventionally recognisable equilibrium between solution and solid phase of macro-dimensions. This necessitated effective separation of the two phases and adoption of a precision technique for liquid phase analysis.

Sucrose of analytical reagent quality was employed and crystals 0·6 mm nominal size were separated by sieving and washing with A.R. methanol. The combined reducing sugar and ash contents of the sucrose were less than 0·01 and 0·02% respectively. A melting point determination gave a value of 188°C which is in agreement with the best recorded value by SHAH and CHAKRADEO[5] for alcohol-precipitated sucrose.

The test materials were introduced into ½-inch "Pyrex" test tubes—5 g water and sufficient sucrose to provide approximately 20% of undissolved crystal in the mixture with saturated solution—and closed with a rubber stopper. The possibility of using all-glass sealed equipment was considered, but the advantages appeared to be outweighed by disadvantages. The test-tubes were clipped to a rack in a water bath which turned them end over end four times per minute.

For conditions at 100°C a larger tube was employed, held in a bath of boiling water with a mechanical wrist-action shaking machine.

After equilibrium had been reached the tube was allowed to stand in a vertical position and undissolved crystals settled to the bottom. The tube was unstoppered after settling was complete and a sample of clear liquid removed with a dry pipette, the orifice in the tip being too small to allow entry of stray crystal.

Temperature control of the water bath was maintained better then ±0·01°C with multiple stirring equipment, and checking of temperature with N.P.L. certificated thermometers. The bath itself was housed in a room at substantially constant temperature (18–20°C) and a cooling coil was employed for low temperature conditions.

The analytical technique selected was to disperse a weighed quantity of sample diluted to approximately 30% concentration on 1 mm glass beads in a glass weighing bottle. This was dried to constant weight in a vacuum oven at 75°C. For weighing procedures a semi-micro, uniform-load balance was employed

[1] *J. Phys. Colloid Chem.*, 1949, **53**, 1334.
[2] *Sugar J.* (La.), 1958, **20**, (1), 14.
[3] *J. Chem. Soc.*, 1955, 2714.
[4] *J. Appl. Chem.*, 1952, **2**, 399.
[5] *Current Science*, 1936, **4**, 652.

reading to 0·01 mg and housed in a room at 19(±1)°C with air humidity of 50–55%.

The determination of total solids by drying and weighing is the only analytical technique able to provide the desired degree of precision.

Equilibrating Time

There are no published data giving rates of solution of sucrose in water which might be usefully employed for control. It seems reasonable, however, to employ the Kucharenko[6] data for rate of crystallization. These have been rationalised to fit equation 1.

$$k = (S - 1)^{1.27} \cdot 33{,}800e^{\frac{-10{,}350}{RT}} \quad \ldots\ldots\ldots\ldots \quad (1)$$

where k = rate of crystallization in g/sq.cm/min,

and $S = \dfrac{\text{g sucrose/g water for solution at } T°K}{\text{g sucrose/g water for saturated solution at } T°K}$

A mean value for k was then calculated between $S_1 = 0$ and $S_2 = 1{\cdot}0$ with the integration shown in equation 2.

$$k_{av} = \frac{33{,}800e^{\frac{-10{,}350}{RT}}}{(S_2 - S_1)} \int_{(S_1 - 1)}^{(S_2 - 1)} (S - 1)^{1.27} \cdot d(S-1) \quad \ldots\ldots (2)$$

From an analogous integration of the surface-weight relationship of sucrose crystals and the calculated change in crystal weight experienced in saturating the solution the mean surface area was calculated.

Conditions of water and sucrose were then adjusted so that saturation conditions could be expected after about 60 minutes at 20°C, and 15 minutes at 100°C. Refractometric tests indicated that rates of solution were at least as great as the Kucharenko rates of crystallization under conditions of adequate stirring. Actual times employed were generally about 3 times the minimum period.

In a previous series of tests[1] it had been observed over the temperature range 20–50°C that no measurable difference could be detected whether saturation was approached from either the over- or under-saturated condition.

The conditions were so designed to minimise the effect of thermal decomposition of sucrose and this seems to have been satisfactorily achieved.

With the relatively large crystal employed, settling was very rapid and separation of liquid phase readily effected.

The results are recorded in table I.

Table I.

Temperature °C.	*Concentration of saturated solution (experimental)*	*(calculated)*
0·0	64.53	64·53
20·0	66·90	66·88
35·0	69·27	69·28
50·0	72·25	72·14
75·0	77·51	77·46
100·0	82·49	82·64
188	100·0	99·90

Discussion

Endeavours to fit an equation of the conventional type (see equation 3) were made by "least square" calculations,

$$C = x + yt + zt^2 \quad \ldots\ldots\ldots\ldots (3)$$

Where C = saturation concentration (sucrose % solution),

t = centigrade temperature,

but the degree of fit was significantly poorer than expected from the precision with which the individual determinations had been carried out. It was found, however, that reconciliation could be effected by considering the system in two groups—50°C and below, and 50°C and above. Equations (4) and (5) were thus obtained. Endeavours to employ higher powered temperature correction terms were not effective.

$$C = 64{\cdot}53 + 0{\cdot}0937t + 0{\cdot}0012t^2 \quad \ldots\ldots\ldots (4)$$

$$C = 61{\cdot}15 + 0{\cdot}2249t - 0{\cdot}0001t^2 \quad \ldots\ldots\ldots (5)$$

The two equations have a common point at 38·64°C which is 7° below the melting point recorded for sucrose hemipentahydrate. It is interesting to note that there is a second temperature in common at 81·68°C which fact could well hinder the identification of the discontinuity from solubility data alone.

If the experimental values of WISE and NICHOLSON be similarly dissected a discontinuity is considered by the author to be identifiable at comparable temperature conditions. A somewhat lower value for the solubility at 0°C is indicated from WISE and NICHOLSON'S results, viz. 62·8%, which may represent the solubility of the anhydrous phase more truly.

The range of values from 50°C and upwards are shown to include the melting point of sucrose. This is considered to be a very rigorous test of the precison of high temperature data as the extrapolation from 100°C to the melting point covers a very substantial change in the molar proportion of sucrose. If an equation is obtained from the author's present results at 50, 75 and 100°C it extrapolates to predict a melting point of 184°C. This is very much closer to the determined value than the value predicted from any other worker's results. Such predicted values are HERZFELD 162°C, GRUT 147°C, WISE and NICHOLSON 164°C and Taylor 151°C.

It is interesting to note that the value recorded here for 100°C is identical with that recorded by FLOURENS[7] in 1876, and 0·48% less than the currently accepted Hertzfeld value. It is felt justified to include the melting point of sucrose as a real point and in fact one which can be specified with more precision than the experimental value at 100°C. The value for 100°C from equation (5) is then indicated as 82·64%. There is a doubt in the mind of the author concerning the real usefulness of the general type of equation commonly employed for representing solubility data but this will be discussed separately.

[6] *Planter and Sugar Manufacturer*, 1928, **80**, 504.
[7] Reduction de Sucrerie indigène (Paris, Rue de Louvois No. 10) 1876.

Conclusion

It is concluded that a discontinuity exists in the solubility of sucrose in water at or about a temperature of 40°C approximating the melting point recorded for sucrose hemi-pentahydrate. The values actually obtained at lower temperatures will be dependent to a certain extent on the technique employed for measurement and mainly influenced by the time of contact between liquid and solid phase. The values here recorded in the higher temperature range can effectively include the experimentally determined melting point of sucrose which is considered to be the most rigorous test for accuracy in this range.

ACETYLATION AND OXIMATION

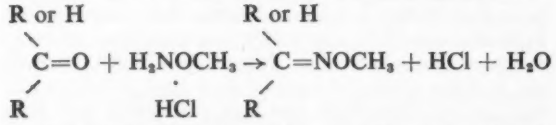
Assay for Certain Oxygen-Bearing Groups in the Dialysed Browning Products from Cane Final Molasses

By W. W. BINKLEY

(New York Sugar Trade Laboratory, 37 Warren Street, New York 7, N.Y., U.S.A.)

ACETYLATION is often effective in the elucidation of the structure of sugars and their polymers. Complete acylation is essential. While the classical acetylating procedures usually employ acetic anhydride and sodium acetate at elevated temperatures and acetic anhydride with either a strongly acidic substance or pyridine at lower temperatures[1] and are broadly applicable to simple sugars, often a carbohydrate polymer will require a specific set of conditions. In this respect the "browning" polymer from cane final molasses presents an interesting challenge. The continued application of heat causes the polymer to become more complex; this change is accompanied by the destruction of certain hydroxyl groups and the formation of water. Mild reaction conditions minimize these changes.

Oximation is a reliable method for the determination of the carbonyl content of sugar polymers[2]. The rate of the reaction with these complex substances is expectedly slower than that with simple sugars. The accuracy of the determination depends considerably then upon the stability of the oximation reagent; therefore methoxyamine hydrochloride is used instead of hydroxylamine hydrochloride. The stoichiometry of the method is illustrated by the following equation.



Each participating carbonyl group releases a molecule of hydrochloric acid. These fundamental reactions of organic chemistry, acetylation and oximation, were used to determine the quantities of certain oxygen-bearing functional groups in the "browning" products from cane final molasses. We wish to report herein the results and some of the structural implications of these findings.

Experimental

Acetylation of the "Browning" Polymer

(*A*) *Formamide as Catalyst and Solvent.*—Two grams of the molasses polymer were dissolved in 30 ml of freshly-distilled formamide and the resulting solution was cooled with a mixture of ice and water. Acetic anhydride (11 ml) was admixed slowly with the cooled solution. The reaction mixture was warmed to and maintained at 30°C for 20 days. It was poured then on to 200 g of a mixture of ice and water and stirred for about 1 hour. This solution was adjusted with distilled water to 500 ml and was dialysed against deionized water for 100 hr in a cellulosic membrane bag (26 in long, 2·25 in dia., 0·0023 in wall thickness). The dialysis apparatus was designed to permit the complete change every 2 hr of the solution outside the membrane bag. The acetylated polymer was isolated by dewatering its aqueous solution partially by reduced-pressure evaporation followed by freeze drying, yield 2·02 g. It was soluble in glacial acetic acid and water, insoluble in acetone; its elemental analysis was C 49·78, H 5·19, N 5·69, O 34·56, ash 4·83 and acetyl 27·83 by the method of Chaney and Wolfrom[3].

(*B*) *Boron Trifluoride as Catalyst.*—The polymer (500 mg) was admixed with a solution of 3 ml of boron trifluoride ethyl ether in 20 ml of acetic anhydride. The resulting mixture was heated to 80–90°C and the polymer began to dissolve. The reaction mixture appeared to be homogeneous after 30 min at this temperature. The reactants were cooled to 30°C and were maintained at this temperature for 20 days. They were poured then on to a 100 g of finely crushed ice and a precipitate formed. After this mixture had been stirred for 1 hr, the precipitate was collected

[1] Hudson: *J. Ind. Eng. Chem.*, 1916, **8**, 380.
[2] Messook and Purves: *Paper Trade J.*, 1946, **123**, (18), 35.
[3] *Anal. Chem.*, 1956, **28**, 1614.

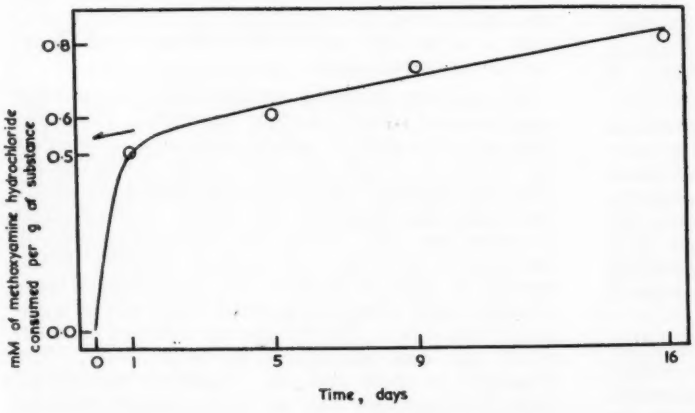
by centrifugation. The acetylated polymer was dried partially in air at room temperature; final drying was achieved at 25–27°C under vacuum with phosphoric anhydride, yield 602 mg. It was soluble in glacial acetic acid, formamide, acetone and pyridine, insoluble in water, partially soluble in ethanol and methanol. The elemental analysis of this acetylated polymer was as follows: C 55·68, H 5·84, N 1·87, O 34·43, ash 2·18 and acetyl 39·2,[3] 39·9[4].

Oximation of the "Browning" Polymer

The molasses polymer (1·30 g) was dissolved in 50 ml of methoxyamine hydrochloride reagent[2] and the reaction was allowed to proceed at 20°C. Aliquots of 10 ml each of the reaction mixture and the reagent alone was titrated with 0·1*N* hydrochloric acid to pH 3·00 after 1, 5, 9 and 16 days; these values were 7·18, 7·10, 6·91 and 6·85 ml for the control and 9·75, 8·87 and 8·60 ml for the reaction mixture, respectively. These results are presented in Fig. 1. The titration of the polymer (0·26 g) alone in 10 ml of distilled water required 3·85 ml of 0·1*N* hydrochloric acid to pH 3·00.

Results and Discussion

Two rather different solvent-reagent systems were used in these acetylation studies, namely, formamide and acetic anhydride, boron trifluoride and acetic anhydride. Formamide was an excellent solvent for both the molasses polymer and the acylating agent



and the reaction was allowed to proceed under homogeneous conditions. The catalytic effect of the amide was not great and the acylation was found to be incomplete even after 20 days (27·83% acetyl in the product). The removal of the solvent was difficult and incomplete. The boron trifluoride-acetic anhydride system possessed some unique advantages. This combination of reagents behaved like a very acidic substance and proved to be an excellent catalyst in this instance. Furthermore it was able at 80–90°C to dissolve the polymer, exemplifying the amphoteric nature of these "browning" products. Acylation was more extensive, perhaps complete; the acetyl content of this polymer derivative was 39·9%, or an average of 6·3 acetyl groups per polymer repeating unit of $C_{17-18}H_{26-27}O_{10}N$[5]. Depending upon the extent of the polymerization, the probable presence of 6 or 7 hydroxyl groups (or their acylation equivalent) in the unmodified unit was indicated. These results confirmed the previous conclusion, resulting from our hydrogenolysis studies[6], that for the most part the fundamental structure of the reactant hexoses had been retained in the polymer.

Primary and secondary reactions occurred during the treatment of the molasses "browning" polymer with methoxyamine hydrochloride (Fig. 1). The primary reaction—conversion of carbonyl groups to oximes—was virtually completed in 24 hours. One gram of polymer consumed 0·53 millimoles of reagent during this phase of the oximation (value obtained by extrapolation). The probable presence of one carbonyl group in every five polymer repeating units was suggested by this value. Carbon to oxygen double bonds constituted a minor fraction of the total unsaturation in the polymer which was found by bromine uptake to possess 1·6–1·8 unsaturated groups per repeating unit[7]. The secondary reaction(s) during oximation consumed about 50% as much reagent as the primary one and this uptake occurred in the 15-day period following the completion of the initial phase of the reaction. The continued limited formation of these carbonyl groups suggested some gradual destruction of the polymer.

Summary

The acetylation of the cane molasses "browning" polymer indicated the probable presence of 6 or 7 hydroxyl groups per repeating unit. Boron trifluoride-acetic anhydride was found to be a suitable solvent-reagent system for this acylation. Distinct primary and secondary reactions were observed during the oximation of the polymer with methoxyamine hydrochloride. The consumption of 0·53 millimoles of this reagent by one gram of the polymer would suggest the existence of one carbonyl group in every five repeating units.

Acknowledgment

A portion of this work was performed under contract A-1s-32692 between the Southern Regional Laboratory of the United States Department of Agriculture and the Ohio State University Research Foundation, Project 427 (Professor M. L. Wolfrom, supervisor). The counsel of Dr. L. F. Martin, Southern Regional Laboratories, and Professor Wolfrom, is gratefully acknowledged. The writer wishes to thank Mr. Alan Chaney of the Ohio State University for his assistance in the acetyl analyses.

[4] Huffman Microanalytical Laboratories, Wheatridge, Colorado, U.S.A.
[5] Binkley: *I.S.J.*, 1957, **59**, 178.
[6] Binkley: *I.S.J.*, 1957, **59**, 64.
[7] Binkley: *I.S.J.*, 1958, **60**, 62.

SYNTHETIC DETERGENT MANUFACTURE

A new market for sugar

By P. W. SHERWOOD.

ONE of the important potential outlets for sugar products is the manufacture of chemical derivatives. The surface of such a sucro-chemical industry has, to date, scarcely been scratched. Yet, there is much long-range incentive in upgrading sugar to products which exhibit strong growth trend and which provide new sources of revenue for the sugar refiners.

Molasses has long been used as raw material for chemical conversion. The approach, in almost every instance, has taken the route of fermentation processes. In the manufacture of simple chemical derivatives, this type of operation can rarely compete with more direct methods of synthesis which are available today. Thus, the production of industrial ethyl alcohol from blackstrap molasses has declined rapidly during the past decade as petrochemical processes have proved a cheaper source. Similarly, acetone and butanol production by molasses fermentation accounts today for only a negligible portion of total output. There remains only the production of citric acid which continues to be based on sugar products, but which is a minor molasses consumer and exhibits only a small growth trend.

Minor quantities of speciality molasses are diverted into the production of aconitic acid and into various edible or pharmaceutical end products. None of them constitutes a major consumer of sucrose.

The first new promising approach toward chemical utilization of sugar is the production of fatty acid esters of sucrose, a group of compounds which show considerable promise as nonionic synthetic detergents. A process of manufacture, developed for these sugar derivatives, was announced in late 1956. It has since been licensed to at least eight companies (including Berkley Chemical Corp. in the U.S. and Howards of Ilford, Ltd. in England).

This product enters the market at a time when the group of nonionic detergents is in a particularly strong growth phase. The outlook is for an increase in U.S. output of nonionics from 210 million pounds in 1956 to 310 million pounds in 1960. Some 60 percent of this production is made up of nonsulphonated esters formed by the condensation of a polyhydric alcohol—or ethylene oxide—with a long-chain acid.

It is in this field that fatty acid esters of sucrose will make their bid. On purely economic grounds, the outlook appears favourable. The price of refined sugar is 9–14c a pound less than that of ethylene oxide and sorbitol, which figure prominently in the manufacture of today's nonionic surfactants. According to one producer, surfactant-type fatty acid esters of sugar can be made for an estimated 13–15c a pound, well below the range of current market price for nonionics of equal detergency.

At the centre of all the attention being given to the production of sugar-based detergents is a process developed by New York's Foster D. Snell Laboratories under sponsorship by the Sugar Research Foundation.

In this process 3 moles of sucrose are contacted with 1 mole of a fatty acid ester of a volatile alcohol (e.g. methyl stearate) in the presence of 0·1 moles of alkaline catalyst. The entire reaction is carried out in a solvent such as dimethyl formamide and potassium carbonate, or a similar weak alkaline salt, is the preferred catalyst.

The entire reaction mixture is held at 90–95°C and 80–100 mm Hg pressure. In the course of reaction, the sucrose molecule replaces the methyl group from the fatty acid ester and methanol is evolved. It is fractionated and recovered in a small plate column which is superimposed on the reaction kettle.

After a reaction time of 9–12 hours, the solvent (dimethyl formamide) is removed and the residue is dried. This product contains about 45 per cent active agent (mainly sucrose monoester of fatty acid such as sucrose monostearate). In addition, it contains 1–2 per cent potassium carbonate and 54 per cent unconverted sugar.

For certain detergent applications, this product may be used without further treatment. For other purposes, however, it will be necessary to separate the sugar, in which case it is to be recovered for recycling purposes. Snell's recommended procedure here calls for dissolving the entire crude product in water and then salting out the sucrose ester by the addition of 5 per cent sodium chloride. If the mixture is held at 80–90°C for some time, a layer of crude sugar esters is separated which can be withdrawn and dried. The product so obtained contains 80–85 per cent alcohol-soluble sugar ester. The remainder is sugar and salt. Complete removal of these contaminants can be accomplished by partitioning between water and 1–butanol. The desired product can be recovered from the butanol layer.

Osipow and his associates at Snell Laboratories have compared the effect of sucrose-based detergents with other detergents which are today employed in heavy-duty service. Results indicate equal detergency in soft water, superior detergency in hard water, when compared to the tall oil polyoxyethylene condensates which constitute the largest group of nonionics in present day service.

The foaming tendency of the sugar esters depends on the fatty acid involved. Sucrose laurate and myristate are reported to be moderate foamers and

sucrose palmitate and stearate are low-foaming agents. This characteristic is particularly important in automatic dishwashers and laundry machines.

Of particular interest is the very low toxicity of sucrose esters which opens a wide field of potential applications in food processing. Also important are the high emulsifying power of sugar-based detergents and the good stability which these materials exhibit.

From the point of view of their physical properties, sugar-derived esters are odourless, tasteless, and non-irritating. They belong to the small group of nonionic detergents which are in solid form.

It is too early to judge the degree of acceptance which these new detergents will receive. They will compete with older surface-active agents in the large established markets. In addition, there is good potential for these detergents in food processing where advantage can be taken of the fact that they are the only efficient water soluble detergents which are completely non-toxic for humans.

Based on these properties, one licensed producer, Berkeley Chemical Corp, foresees employment for sugar-based detergents in such applications as washing fresh fruit and vegetables, emulsifying foodstuffs such as ice cream, shortening, confectionery, etc., cleaning food processing equipment. Use is also foreseen as emulsifiers in cosmetics and toiletries.

This development may well be the first major move in the creation of a sucrochemical industry. Success should encourage more extensive research into this field which holds much potential for upgrading sucrose to more profitable products.

SOME ASPECTS OF LOW PRODUCT MASSECUITE TREATMENT

By O. H. PHIPPS

Abridged from the paper presented to the 11th Tech. Conf., British Sugar Corp., 1958.

PART I.

Treatment in the Vacuum Pan.

As the boiling of syrup to massecuite is the first stage in the aim to obtain the maximum sugar extraction the massecuite should be exhausted as fully as possible in the pan before it goes to the crystallizers. Some writers in fact, contend that it is impossible to adjust in the crystallizers errors made in the pans.

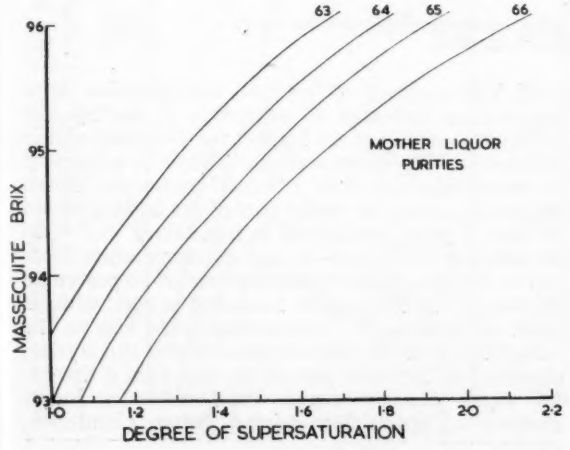


Fig. 1

The degree of exhaustion of the massecuite at the end of the boiling, as measured by the purity of the mother liquor, will depend upon the Brix, purity, temperature and degree of supersaturation of the massecuite. This is illustrated in Fig. 1, where massecuite Brix is plotted against degree of supersaturation for mother liquor purities of 63 to 66 inclusive, and a massecuite of 78 purity at 78°C. The calculations for the graph are based upon E. W. Grut's solubility table for beet sugar at different purities and temperatures ; and by degree of supersaturation is meant the ratio of sugar to water in the solution, divided by the ratio of sugar to water in a saturated sugar solution at the same temperature and purity.

From Fig. 1 it is evident that for any given degree of supersaturation the higher the massecuite Brix (and hence the mother liquor Brix) the lower the mother liquor purity becomes. Thus for a supersaturation of 1·5 a massecuite Brix of 95·6° is required to reach a mother liquor purity of 63, a purity which is hardly likely to be reached in practice at 94° Brix since the syrup would then be approaching the fully exhausted condition (i.e. saturation point) and the rate of crystallization, which is dependent upon the

[1] *Ind. Eng. Chem.*, 1956, **48**, 1459–64.
[2] *Chem. Eng. News*, 1956, 5926.
[3] *Soap and Chemical Spec.*, January 1957, 153.
[4] *Can. Chem. Proc.*, November, 1954, 74.
[5] *Chem. Week*, 8th October 1955.

degree of supersaturation, would be approaching zero.

In Fig. 2 a, b and c, rates of crystallization are plotted against degree of supersaturation for three purities of 100, 80 and 60 respectively at temperatures of 30°C, 40°C, 50°C and 60°C. These graphs clearly illustrate the very great influence of both purity and temperature on the crystallization rate, and that a maximum occurs for both 100 and 80 purity at about 1·4 supersaturation, due possibly to the "driving force" of further increasing the supersaturation beyond the point being more than counterbalanced by the retarding effect of the increasing viscosity.

In Fig. 2c the maximum is not apparent, but it is so in curves prepared by other workers, amongst whom are GRUT (Fig. 3) and MCGINNIS *et al.*[1] (Fig. 4). The curves due to GRUT are interesting in so far as not only do they show a maximum at about 1·5 to 1·6 supersaturation, but also large differences in rates of crystallization at very similar purities and apparently the same solubilities, 'apparent solubility' since the curves should cross the abscissa at 1·0 if the supersaturations had been true. That is to say, supersaturation at low purities is thus a very uncertain figure. The results of MCGINNIS and his co-workers show that for maximum rate of crystallization the degree of supersaturation is critical at 1·49.

Whatever the explanation of this maximum it is evidently important that it should be found and maintained not only in the vacuum pan, but also in the crystallizer, since only a limited time is available for both processes in the factory. DEDEK summarises this by stating that with the same factory plant the lowest molasses purities would be obtained if throughout the operation the maximum rate of crystallization could be obtained.

On this principle therefore, and from the evidence of the graphs the conclusions are that :—

(1) The pan should be brought into grain on the highest possible syrup purity since then the rate of crystallization will be greatest and the Brix lowest at any given degree of supersaturation and temperature, so that the required amount of grain will tend to form instantaneously and thus avoid in the final massecuite a mixture of small and large crystals with its adverse effect in the centrifugals.

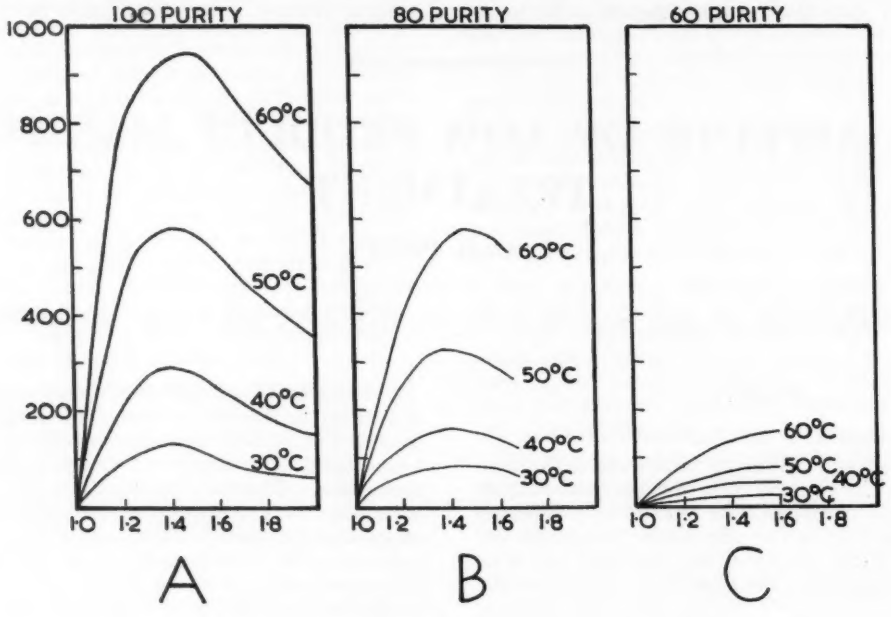


Fig. 2
Rate of Crystallization as a function of the purity, supersaturation and temperature
(Werkspoor Bericht No. 4 Aug. 1938).

(2) The increase of rate of crystallization with temperature indicates an advantage in boiling low purity massecuites at the highest possible temperature without causing decomposition. Thus it is advocated by some technicians that a 'looser' massecuite should be carried during the major part of the boiling period so that a good circulation is maintained and local overheating minimised—a rise in temperature from top to bottom of the massecuite cannot be prevented because of the hydrostatic head and in fact, without good circulation, the temperature could rise to the extent that syrup becomes undersaturated and crystals dissolved in the lower part of the pan even if there is no sugar decomposition. Furthermore a looser massecuite, apart from giving better circulation,

[1] *Ind. Eng. Chem.* 1942, **34**, 173.

means that the average purity of the mother liquor must be slightly higher than in a pan carried 'tight' all the way up, and these two factors are said to more than counterbalance the effect of the higher degree of supersaturation on the rate of crystallization, thus resulting in a shorter boiling time. That is, of course, not to say that a shorter boiling time should be regarded as an aim, unless factory conditions demand, for the longer the massecuite is maintained in the pan under the right conditions the greater the exhaustion of the syrup. Also the final 'heavying-up' should in no case be so hurried that the rate of evaporation exceeds the rate of crystallization, and in this respect it is possible to form some judgement of the pansman's work from the relationship between massecuite Brix and mother liquor purity as indicated in graph 1.

It has been shown that for a low purity mother liquor a comparatively high Brix massecuite must be boiled. Nevertheless the Brix obtained in practice must be to some extent a compromise to suit factory conditions, e.g. heating surface of pans, steam pressure etc., and if the Brix must necessarily be kept on the low side this does not mean that final molasses purity will for certain be on the high side. For example, if massecuites of 78 purity are boiled to the appropriate Brix and same supersaturation to yield mother liquor purities of 66, 65, 64 and 63 and all eventually yield molasses of 60 purity and same supersaturation, then the amounts of crystallization per cent on dry substance in the massecuites taking place in the crystallizer are respectively 9·71, 7·86, 6·11 and 4·46. Then for the same time in the crystallizer the average rates of crystallization over the period would have to be in the ratios 2·18 : 1·76 : 1·37 : 1, i.e. the same as the ratio of the amounts of sugar crystallized. From our knowledge of the effect of purity or temperature on rates of crystallization it is feasible, but not proveable, that the higher average purities throughout the crystallization period, consequent upon the higher mother liquor purities at the start, would allow the appropriate rate to be obtained. It is probable however that time in the crystallizer is the dominant factor rather than the average purity in obtaining the same final purity of the molasses. In other words if crystallizer capacity is limited the maximum possible exhaustion should be obtained in the pan where it will be achieved quicker than in the crystallizer. P. M. SILIN has in fact suggested that the massecuite should be boiled to a high Brix (say 96°), eliminating supersaturation by holding in the mixer at 80°C for 10 to 12 hours and then centrifugalling at this temperature without permitting further cooling.

By this method it can be shown theoretically that very low molasses purities are obtainable because of the small amount of water present, but of course the Brix of the molasses must be high (92 to 93°) and also the crystal content of the massecuite. Consequently how such a massecuite would behave in the centrifugals is a matter for speculation, for there must occur quite a considerable drop in temperature during spinning and thus an increase in viscosity. It does, therefore, appear doubtful that this is a very practical method of achieving the best of both worlds—a high exhaustion in the pan and rapid crystallization in the mixer due to the high temperature.

An alternate method of treatment due to A. MIRCEV[2] is to dilute the high Brix massecuite just before striking by adding most of the water normally added whilst cooling in the crystallizer. (Other workers have suggested adding dilute molasses to the massecuite in the pan). Striking is then said to be easier, less steam required for cleaning the pan, the time of ripening reduced by 5 hours and the 'ripening' effect improved, as shown by a molasses purity 0·8 lower on average. J. VOCU[3] has reported good results by this method.

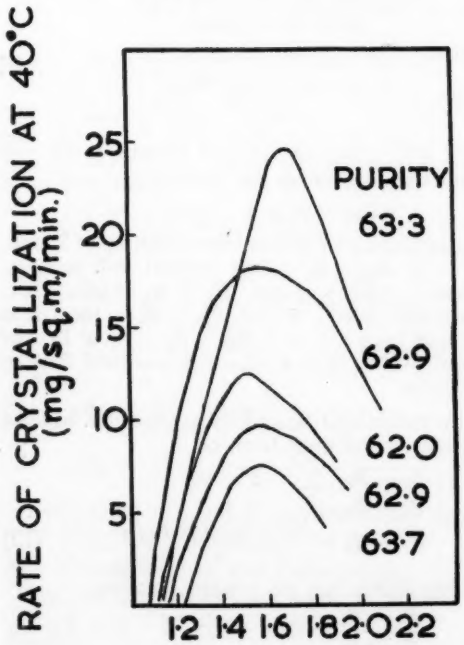


Fig. 3

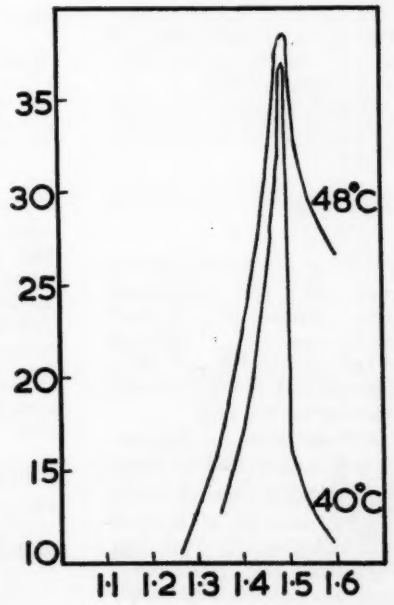


Fig. 4

[2] *Listy Cukr.*, 1952, **68**, 215–219.
[3] *S.I.A.*, 1953, **15**, Abs. 691.

The advantage in this method seems to be in the fact that, by adding water to the massecuite in the pan, mixing takes place quicker and more thoroughly than in the crystallizer so that a more homogeneous massecuite in the right condition is obtained at the start of the cooling process. This method however poses the question of how much water to add and this will be dealt with below.

(To be continued)

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UTILITY OF THE FORMULA FOR CALCULATING EFFICIENCY OF IMBIBITION

New Calculations for Ideal Brixes of Secondary Juices, Brix-Curves and their Interpretation

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PART I

IT is well known that whenever the efficiency of a milling tandem decreases, with increase of pol % bagasse, investigations are made to find out the causes. In such cases, the mill setting, i.e. the opening between the two rollers, receives most of the attention paid by the sugar engineers, as the common belief is that it is this which most influences the extraction of juice. Unfortunately, there is no formula established so far for the calculation of mill setting under factory conditions, and therefore mill opening is set empirically. The best method at hand for establishing whether a certain mill setting is loose, is to compare the actual Brix of juice expressed with the theoretically-calculated ideal Brix of juice from that mill. The calculations of ideal Brix are based upon the assumptions that all the imbibition liquid takes part in diluting the residual juice in bagasse or, in other words, the efficiency of imbibition is 100%.

With this assumption, Mittal's formula[1] provides a convenient base for the calculation of ideal Brixes. The formula stands as follows :

$$X_n = \frac{100}{\frac{B_{n-1b} - B_{n+2}}{B_{n+1} - B_{n+2}} - \frac{100 \times W}{m \times b}} \quad \ldots\ldots\ldots\ldots (1)$$

where X_n = efficiency of the imbibition process on bagasse coming from the nth mill ; W = imbibition water % cane ; m = residual (diluted) juice % final bagasse ; b = final bagasse % cane ; B_{n+1} = Brix of juice expressed by the $(n+1)$th mill, and B_{n+2} = Brix of juice expressed by the $(n+2)$th mill. B_{n-1b} is the Brix of juice in bagasse entering the nth mill.

NOTE :—In the case of imbibition on bagasse entering the last mill, B_{n+2} = Brix of imbibition water (which is usually equal to zero), and B_{n-1b} is calculated by the general equation :

$$B_{nb} = \frac{B_{n-1b}\, mb + 100\, W_n\, B_{n+2}}{mb + 100\, W_n} \quad \ldots\ldots\ldots\ldots (2)$$

and $W_n = WX_n/100$ ..... (3)

Now if the efficiency of imbition on bagasse coming out of the nth mill be 100%, equation (1) reduces to :

$$100 = \frac{100}{\frac{B_{n-1b} - B_{n+2}}{B_{n+1} - B_{n+2}} - \frac{100\, W}{mb}} \quad \ldots\ldots\ldots\ldots (4)$$

$$\text{or } \frac{B_{n-1b} - B_{n+2}}{B_{n+1} - B_{n+2}} = 1 + \frac{100\, W}{mb} = c \text{ (say)} \ldots\ldots\ldots (5)$$

$$\text{or } B_{n-1b} = cB_{n+1} - (c-1)\, B_{n+2} \quad \ldots\ldots\ldots\ldots (6)$$

Equation (2) reduces to :

$$B_{nb} = \frac{B_{n-1b}\, mb + 100\, WB_{n+2}}{mb + 100\, W} \quad \ldots\ldots\ldots\ldots (7)$$

since $W_n = W$, X_n being equal to 100 (from eq. 3)

$$\text{or } B_{nb} = \frac{B_{n-1b}\, mb + (c-1)\, mb\, B_{n+2}}{mb + (c-1)\, mb}$$

since $100W = (c-1)\, mb$ (from eq. 5).

$$\text{Thus } B_{nb} = \frac{B_{n-1b} + (c-1) \times B_{n+2}}{c}$$

$$\text{or } B_{n-1b} = c \times B_{nb} - (c-1) \times B_{n+2} \ldots\ldots\ldots (8)$$

By comparing equations (6) and (8),

$$B_{nb} = B_{n+1} \quad \ldots\ldots\ldots\ldots (9)$$

Now considering a mill tandem consisting of 5 mills, when $n = O$, $B_{0b} = B_1$ = Brix of first mill juice or the primary juice ; $n = 1$, $B_{1b} = B_2$ = Ideal Brix of second mill juice ; $n = 2$, $B_{2b} = B_3$ = Ideal Brix of third mill juice ; $n = 3$, $B_{3b} = B_4$ = Ideal Brix of fourth mill juice ; $n = 4$, $B_{4b} = B_5$ = Ideal Brix of fifth mill juice.

Now for the imbibition on first bagasse (i.e. bagasse entering the second mill) from eq. 5,

$$\frac{B_1 - B_3}{B_2 - B_3} = c$$

$$\text{or } B_2 = \frac{B_1 + (c-1) \times B_3}{c} \quad \ldots\ldots (10)$$

and for the imbibition on second bagasse,

$$\frac{B_2 - B_4}{B_3 - B_4} = c$$

[1] *I.S.J.*, 1958, **68**, 231–233.

or $$B_3 = \frac{B_2 + (c-1) \times B_4}{c} \quad \ldots\ldots\ldots (11)$$

Substituting the value of B_2 from (10) in (11) and on simplification

$$B_3 = \frac{B_1 + (c-1) \times c \times B_4}{c^2 - c + 1} \quad \ldots\ldots\ldots (12)$$

Similarly for the third bagasse,

$$B_4 = \frac{B_1 + (c^3 - 2c^2 + 2c - 1) \times B_5}{c^3 - 2c^2 + 2c} \quad \ldots (13)$$

and for the fourth bagasse (assuming the Brix of imbibition water to be O)

$$B_5 = \frac{B_1}{(c^2 - c + 1)(c-1)^2 + c} \quad \ldots\ldots\ldots (14)$$

Substituting the value of B_5 from eq. 14 in eq. 13.

$$B_4 = \frac{B_1 \times c}{(c^2 - c + 1)(c-1)^2 + c} \quad \ldots\ldots (15)$$

and on substitution of the value of B_4 from eq. (15) in eq. (12),

$$B_3 = \frac{B_1 \times (c^2 - c + 1)}{(c^2 - c + 1)(c-1)^2 + c} \quad \ldots\ldots\ldots (16)$$

and similarly from the equations 16 and 11,

$$B_2 = \frac{B_1 \times c \times (c^2 - 2c + 2)}{(c^2 - c + 1)(c-1)^2 + c} \quad \ldots\ldots\ldots (17)$$

By following the same procedure, expressions for ideal Brixes of juices from mills of a tandem consisting of different number of mills can be deduced.

For a milling tandem consisting of 4 mills, the ideal Brix expressions are as follows :

$$B_2 = \frac{B_1 \times (c^2 - c + 1)}{c \times (c^2 - 2c + 2)} \quad \ldots\ldots\ldots\ldots (18)$$

and $$B_3 = \frac{B_1}{c^2 - 2c + 2} \quad \ldots\ldots\ldots\ldots\ldots (19)$$

and $$B_4 = \frac{B_1}{c \times (c^2 - 2c + 2)} \quad \ldots\ldots\ldots\ldots (20)$$

and for a milling tandem consisting of 6 mills, the ideal Brix expressions are as follows :

$$B_2 = \frac{B_1 \times [(c^3 - c + 1)(c-1)^2 + c]}{c(c^2 - 3c + 3)(c^2 - c + 1)} \quad \ldots (21)$$

$$B_3 = \frac{B_1 \times (c^2 - 2c + 2)}{(c^2 - 3c + 3)(c^2 - c + 1)} \quad \ldots\ldots (22)$$

$$B_4 = \frac{B_1}{c \times (c^2 - 3c + 3)} \quad \ldots\ldots\ldots\ldots (23)$$

$$B_5 = \frac{B_1}{(c^2 - 3c + 3)(c^2 - c + 1)} \quad \ldots\ldots (24)$$

$$B_6 = \frac{B_1}{c \times (c^2 - 3c + 3)(c^2 - c + 1)} \quad \ldots (25)$$

The values of c and B_1 can be readily determined from the daily routine analysis records.

New Calculations vs. Old Calculations.

The old calculations are made as follows :

$$X_m = \frac{1 + S + S^2 + \ldots + S^{m-1}}{1 + S + S^2 + \ldots + S^{m-1} + \ldots + S^n} \times X_{n+1}$$

where n = number of secondary mills in the tandem,
X_m = the ideal Bx of mth mill juice,
X_{n+1} = Bx of first mill juice or the primary juice,
S = W/f in which,
W = imbibition water % cane,
and f = fibre % cane.

Assumptions which are made in the derivation of the above old formula are,
that (*a*) fibre % bagasse is equal to 50 and hence the residual juice % bagasse is also equal to 50 ;
and (*b*) total juice expressed by a mill is equal to the imbibition water added on the last mill.

The assumption (*b*) is justified to a great extent in practice but assumption (*a*) is far from being true. In fact, fibre % bagasse varies between wide limits and cannot be taken as constant and equal to 50. The further its value is away from 50, the more erroneous are the results obtained by the old equations. This seems to be the reason why the ideal Brix curves, when compared with the actual Brix curve, at times give misleading information. The assumption (*a*) is eliminated from the new calculations and the actual values of fibre % bagasse is taken into consideration. The values of ideal Brixes calculated with the new formulae taking assumption (*a*) as true, coincide with those calculated by the old calculations. The comparison of the two calculations can be well understood from a practical example cited below.

Let number of mills in the tandem = 5
Bx of first mill juice, B_1 = 20·00
Water added % cane, W = 15·60
Fibre % cane, f = 12·34
Bagasse % cane, b = 26·00
Residual juice % bagasse, m = 52·54

then, $S = W/f = 15{\cdot}60/12{\cdot}34 = 1{\cdot}264$

and $c = 1 + (100 \times W)/(m \times b)$
$= 1 + (100 \times 15{\cdot}6)/(52{\cdot}54 \times 26{\cdot}0)$
$= 2{\cdot}14$

and the ideal Brixes of the juices are as follows :

TABLE I.

Mill Juice	Old Formula	New Formula
II	13·94	14·89
III	9·15	10·41
IV	5·37	6·48
V	2·37	3·03

Now if fibre % bagasse = 50, bagasse % cane
$= 12{\cdot}34 \times 100/50$
$= 24{\cdot}68$

and $c = 1 + (100 \times 15{\cdot}6)/(50 \times 24{\cdot}68) = 2{\cdot}264$

and with the value 2·264 for c, the ideal Brixes calculated from the new formulae are : 13·94, 9·15, 5·37, and 2·37 of the juices from second to fifth mills respectively, and these are exactly the same as were obtained from the old formula.

(To be continued)

Economy in Filter Area for Standard Liquor Filtration. M. B. HARRIS. *J. Amer. Soc. Sugar Beet Tech.*, 1957, **9**, 536–543.—The economics of filtration are discussed with consideration of filter area, flow rate, cycle length, volume of liquor per cycle per filter, the number of filters used, labour, replacements, and cloth costs. Internal and hand sluicing filters are included as well as the horizontal leaf and plate-and-frame filters.

* * *

Wire Mesh Entrainment Separators. J. E. COOLEY. *J. Amer. Soc. Sugar Beet Tech.*, 1957, **9**, 544–549.—The use and economics of wire-mesh entrainment separators are discussed. The double-grid separator has been found more suitable than the single-grid, and tests have shown that an average of 85% reduction in sugar entrainment is effected. The average pressure drop across the separator used in the tests was 0·3 inches water gauge. Advantages include: less danger of damage to the boiler interior caused by excessive sugar in the boiler feed; increase in boiler capacity; and longer life to vapour and condensate lines and to condensate pumps.

* * *

Modernization of the Oldest Sugar Factory in Taiwan, the Chiatow Factory. Y. H. SOONG. *Taiwan Sugar*, 1957, **4**, (10), 13–16.—Details are given of the modernization programme started in 1956, which is intended to increase the capacity of the Chiatow factory from 2000 metric tons to 2600 tons cane per day and to reduce the season from 190 to 150 days, so overcoming difficulties with unripened and over-ripe cane. It is hoped to increase sugar yield from 12·5 to 13%, giving 1750 tons of additional sugar per year. The project should be finished by the winter of 1958.

* * *

Boiling Schemes — Advantages and Disadvantages. J. D. TANEJA. *Indian Sugar*, 1957, **7**, 457–459.—The merits and demerits of the various boiling schemes are discussed. The three-boiling system is considered the most advantageous.

* * *

Practical Maintenance of Electric Motors Pays Dividends. G. R. POWERS *et al. Sugar J.* (La.), 1957, **20**, (7), 6–11.—Effective maintenance of electric motors is discussed and advice given on methods of overcoming certain operating defects. A list of symptoms, causes and cures is also given.

* * *

The Caking of Soft White Superior. S. ABE. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1957, **6**, 1–7.—The relationship between original moisture and invert sugar content of Soft White Superior sugar and its caking during storage in atmospheres of various R.H. has been studied. The method of DOUWES DEKKER[1] was used, the sugar samples being stored over appropriate salt solutions in desiccators at 20°C. The degree of caking was determined by spreading 100 g of sugar evenly in a 20 mm deep dish of 90 mm dia. and storing for a week in the desiccator, after which a 30 mm metal cylinder was placed on the sample and a beaker placed on top of this. Mercury was added until the sugar sample broke. The initial moisture and invert sugar content and the equilibirum moisture content after 1 week's storage at various R.H.'s are tabulated together with the degree of caking. A correlation was found between the ratio of moisture loss: invert sugar and the degree of caking, the correlation coefficient being 0·918. The equilibrium moisture content of Soft White Superior depends only on the initial invert sugar content and the R.H. during storage. The following formula was developed:

$$M_e = 0{\cdot}01748\ H + 0{\cdot}2430\ I - 0{\cdot}6782$$

where M_e = equilibrium moisture content, H = relative humidity, and I = invert sugar content. The caking may be prevented by adjusting the invert sugar and initial moisture content.

* * *

Investigation of Crystallizer Operation. A. TAKEI. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1957, **6**, 8–13.—A study was made of the effect of massecuite Brix, temperature when dropped, and temperature at purging on sugar yield. Correlation was found between Brix and the sugar yield, expressed by:

$$y = 1{\cdot}42x - 64{\cdot}59$$

where y = yield, and x = massecuite density. It was also found that increased temperature at discharge caused decreased sugar yield, while low temperature at purging, even where the Brix is low, causes an increase in the yield. Heavy boiling to 90°Bx produces a higher yield even though the massecuite temperature rises slightly. Use of saturated syrup to dilute the massecuite for further cooling gives an increase in sugar yield.

* * *

Decolorization of Sugar Liquor through Fixed Beds of Granular Activated Carbon (Pittsburgh CAL). S. ASAI, M. IRITA and T. KIKUCHI. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1957, **6**, 14–22.—Carbonatated liquor from affined raw sugar was decolor-

[1] *I.S.J.*, 1941, **43**, 224.

ized by passing through CAL granular carbon at 80°C, four columns 44 cm long and containing 100 g of carbon being used in series. The colour of the effluents was then determined photoelectrically at 420 mμ. Graphs of liquor throughput *vs.* colour of effluent show that the deeper the carbon bed the more constant was the colour break-through. Overall and liquid mass-transfer coefficients are calculated; the latter were much greater, so that major resistance to diffusion under the experimental conditions was within the solid phase. Using these values the basic data for carbon beds in a refinery producing 100 tons of melt per day is calculated from formulae. Three towers of 1·4 m dia. and 6 m depth would give an effluent having less than 40% of the original colour, the filtering cycle of each tower being 12 days. Sweetening-off graphs, in which Brix is plotted against volume throughput for each column, show a slightly flattened curve with increased carbon depth and flow rate, while the sweetening-on curves have more gentle slopes.

* * *

Studies of the Refining Characteristics of "Duolite A-120" for Cane Sugar Solutions using the Chloride Cycle. S. IWASHINA, T. MIYAO and T. ASAMI. *Proc. Research Soc. Japan Sugar Refineries' Tech.* 1957, **6**, 23–35.—Experiments with "Duolite A-120" on the chloride cycle for decolorizing raw sugar solutions are discussed. The results show that: the resin porosity is formed without reduction of the cross-linkage, the porous structure being different from that of most low cross-linked resins; the quantity of amine leakage is small; the effluent clarity was better than with other porous anion exchange resins; the resin was physically stronger than other porous types; the colour contamination was slight, and the regeneration was superior to that of the other resins. The use of oxidizing reagents is not recommended for regeneration as the functional groups of the resin may be oxidized as well as the organic impurities. Solutions of salts such as sodium chloride or dilute acid solutions are recommended for washing.

* * *

Thermal Economy in a Sugar Refinery. H. UESUGI. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1957, **6**, 36–41.—The heat distribution at the Kobe refinery of Taito Co. Ltd. is described with the aid of a heat flow diagram. Thermal recovery is 20·3% of the total heat and is as follows: 2·6% in economizers; 2% in water heaters; 8·2% in the vacuum pan condensate recovery; 2% in the flash steam recovery from the pan condensate, which is fed to a simple condenser to heat the supplementary boiler feed water; 5·4% in the char cisterns wash water, which at 80°C can produce the same amount of water at 75°C by the use of a plate-type heat exchanger; and 0·1% in condensate recovery from the sugar-house. Heat recovery from vacuum pan waste vapour by means of spiral-type heat-exchangers is under consideration. A method of burning pulverized fuel is described.

The Heat Consumption in the Sugar Refinery. S. KOBAYASHI. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1957, **6**, 42–48.—Steam balance diagrams used to calculate the steam consumption in the Toyosu refinery of Nissin Sugar Mfg. Co. Ltd. are reproduced. Efficiency of heat consumption is 77·85%, and the flue gas temperature is 170°C. It is pointed out that, although the dew point of the flue gas is 50°C, there is danger of corrosion from SO_3 if flue gas temperature is lowered too far when heavy oil is burnt.

* * *

Thermal Problems in Sugar Production. W. DE PROSKOWETZ. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1957, **6**, 86–109.—Steam economy in the sugar factory is reviewed with 48 references to the literature. A steam production scheme for a beet sugar factory with a daily capacity of 2400 tons of beet is proposed and illustrated with a diagram. A draught of 126 and thick juice production at 30% on beet is assumed, with thin and thick juice densities of 13·5 and 57°Bx respectively, and 96% water to be evaporated. T. ULFHEDEN's patented evaporation scheme[1] is used, in which only 13% on beet is evaporated, this possibly being reduced by applying the method to high raw massecuite, mixing affined low-raw sugar with high-raw wash. 20 tons of steam/hr at 180 atm and 620°C, produced by a single boiler, is sent to a back-pressure turbine at 150 atm. and 600°C decreasing to 60 atm and 470° and generating 2600 kW. Washing the exhaust steam after the turbine with water at 100°C yields 1·4 tons of steam at 143°C. The evaporator station comprises six bodies, the heating surface increasing from 570 to 2630 sq. m. in the last effect. Each of the bodies evaporates 16% on beet, the vapour being drawn off from the last body only at 112°C for diffusion and the heaters. Sixteen tons per hour (% on beet) of steam is fed to the first body, the temperature drop from body to body being 4°C + boiling point rise. The residual 5·4 (% on beet) tons/hr of steam is used to heat the thin juice from 120°C to 143°C. The pan vapours at 13 tons/hr are compressed by a turbo-compressor from 0·25 atm. (65°C) to 1·50 atm (110°C) as at the Aarberg factory in Switzerland. Although the evaporators are 50% larger than the conventional ones and despite the expensiveness of the compressor and vapour-washer as well as the 1500 kW motor, the economy in steam should be at least 20 and possibly >30% on beet.

* * *

A Fully Automatic White Sugar Centrifugal. B. BRUKNER. *Zucker.*, 1957, **10**, 540–543.—White sugar centrifugals with a pneumatically-operated feeding device designed and patented by P. FRICKE were operated at Nordstemmen factory during the 1957 off-season refining. The centrifugals are designed for operation at 1500 r.p.m. with a *g* force of 1700 kg/m² and capacity is 600 kg. This amount of massecuite

[1] *Swed. Pat.* 155,754, (1956).

is fed from retention tanks below the minglers in 4–5 sec through four jets in series at a pressure of 2–4 atm. The jets are mounted tangential to the drum casing and the flow is in the direction of rotation of the drum, thus obviating the need to reduce speed and the danger of crystal damage. No oscillations are caused as the massecuite is fed evenly. A contact wheel gives the impulse actuating the cut-out valve. Steam is sprayed through the jets to remove any residual massecuite. The maximum speed is reached in a few seconds despite the high *g* force. A yield of 5·1 tons of white sugar has been obtained when operating at the rate of 17 charges/hr of 300 kg per charge. (A maximum of 6·5 tons white sugar per hr/centrifugal has been obtained from beet sugar). A reversible screw conveyor replacing the floor traps delivers the discharged sugar to vibratory conveyors. Discharging with a 200 mm plough can be completely automatic, and takes 25 sec. The control box contains a switch for converting manual to automatic control.

* * *

New Developments in Cuban Fabrication. J. C. GONZÁLEZ MAÍZ. *Sugar y Azúcar*, 1957, **52** (12), 36–37.—A review is presented of apparatus installed and processes adopted during 1957. Equipment includes cane car unloaders, shredders and "percussion knives", imbibition water computers, automatic pH controllers for clarification, the new Dorr-Oliver "D.S.M." juice screen, modern evaporators (many with automatic return and level controls), and high-speed centrifugals. A number of factories are adding soda ash when liming to reduce lime salts and sugar ash; scale inhibitors are now more or less general to lengthen the period between cleaning; the Forn process of cooling somewhat high-purity second strikes and the Webre two-massecuite system are finding favour. Some factories are obtaining benefit from CEPI apparatus while others are not; possible reasons for the latter are suggested.

* * *

Possible use of "Versene" in Increasing Sugar Recovery. S. N. G. RAO and N. A. RAMAIAH., *Sugar y Azúcar*, 1957, **52**, (12), 46.—See *I.S.J.*, 1958, **60**, 298.

* * *

Scale Trap. A. K. GOPAK. *Sakhar. Prom.*, 1957, (12), 47.—A trap for removing rust, etc. entering ammoniacal condensates from corroded heating and supply pipe surfaces is described. A vessel carries a centrifugal screen, through which the water is pumped to the vacuum-filter wash-water tank. The screen is cleaned by back-washing with the unfiltered water, which is admitted by a second branch of the supply pipe on the discharge side of the screen, using appropriate valves. The use of the trap for water used to wash white sugar centrifugals is advocated.

* * *

Mechanical Bag Counter. A. V. KISELEV. *Sakhar. Prom.*, 1957, (12), 48.—The sugar-filled bags pass on the belt conveyor from the bagging station to the storehouse through a flap suspended from a shaft, the movement of which turns gears located at one end. These in turn actuate the electric counter.

* * *

Seeding of Massecuites. A. MIRCEV. *Listy Cukr.*, 1957, **73**, 273–279.—The various methods of massecuite seeding and the factors governing crystallization in the pan are discussed. Calculation of the amount of fine homogeneous seed required using the following formula is demonstrated:

$$\% \text{ seed} = 100\left(\frac{a_2}{a_1}\right)^3$$

where a_2 = size of grain in seed and a_1 = size of massecuite crystal required. The disadvantage of using too much seed is discussed and the use of amounts smaller than the calculated amounts at low supersaturation is advocated to avoid false grain formation. Seeding in the metastable zone (1·0–1·2) is shown to be necessary for the formation of good quality sugar. Tests carried out at Brodce and Dobrovic factories (the latter is also a refinery) are described; grain uniform in size and shape was obtained with 1st raw sugar boilings when homogeneous seed of 0·035–0·060 mm (0·40 mm) grain size was used. The amount of seed used was three-quarters of that calculated, and boiling was at 1·04–1·11 supersaturation for slow crystal growth. Attention is drawn to critical supersaturation, which lies in the metastable zone, during which no seeding may take place. Although the tests were carried out with massecuites from thick syrup, the method is suitable for refinery massecuite boiling.

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Evaluation of Jute Fabrics. S. ZAGRODZKI and Z. NIEDZELSKI. *Gaz. Cukr.*, 1957, **59**, 317–320.—Six jute filter-cloths were tested on filtration of laboratory-prepared juice corresponding to 1st carbonatation juice. The fastest filtration was with Jute 2, of 73 and 72 threads/10 cm warp and weft respectively, and weighing 785 g/sq.m., which filtered 100 ml juice in 99·1 sec, although the filtered juice contained 6·16% muds. Jute 4, of 94 and 72/10 cm warp and weft weighing 796 g/sq. m., took 125 sec to yield the cleanest juice of the 6 samples, containing 1·62% muds. Adhesion of the muds to the cloth was tested by placing the brass ring of a dynamometer over the filter cloth and applying weights attached to a scale. The weight needed to separate the cloth from the mud was recorded, as well as the force needed to overcome the frictional resistance. The latter was subtracted from the former result and the weight needed to remove the mud given as 105 g for Jute 2 compared with 120 g for Jute 4.

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Type IPC–B2 Brix Meter. H. DABROWSKI. *Gaz. Cukr.*, 1957, **59**, 325–326.—The density meter designed by S. DEBSKI and S. SLIWIŃSKI, and installed in about 45 factories, operated successfully during the 1956/57 campaign. It comprises a tube mounted

on a hollow sphere at the end of a counterweighted beam. Liquor flows through rubber connexions to and from the tube, causing the beam to take up a position where a pointer, mounted at the pivoting point, indicates the appropriate reading on an arcuate scale, calibrated in °Bx from 10 to 50°Bx. The error of the instrument is ± 0·5°Bx.

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Two-Speed Motors for Centrifugal Drives. K. LOJ. *Gaz. Cukr.*, 1957, **59**, 327–328.—Details are given of a two-speed Polish squirrel-cage induction motor, with electrical braking, which operates at 470 r.p.m. (12 poles) and 990 r.p.m. (6 poles). The braking system operates from 990 to 500 r.p.m., below which speed mechanical braking must still be used. Circuit diagrams are given and the advantages and disadvantages of the motor given. Advantages include low starting power requirements, fast acceleration and low power consumption; disadvantages include loosely constructed housing.

* * *

Problems of the Coke-Fired Lime Shaft-Kiln. H. EIGEN. *Zucker*, 1958, **11**, 5–9.—Investigations into the problems of coke-fired shaft-kilns are discussed. The deoxidation zone is substatially higher than the coke-combustion zone and starts where the surface temperature of the charge is about 850°C and where this is about 900°C. A well insulated kiln with a heat consumption of only 800–850 kcal/kg lime will have a deoxidation zone about 6–7 m high. The higher the zone the higher the daily lime capacity per sq. m. of shaft cross-section. The view is held (contrary to other opinions) that the height of the combustion (oxidation) zone is inversely proportional to the amount of coke feed, and will be considerably higher as the diameter of the coke is increased, owing to reduction in the middle combustion temperatures and the consequent drop in the specific reactivity. The use of large coke (e.g. 80 mm dia.) will substantially increase the combustion zone temperature. The highest capacity will be obtained where small particle limestone is used with large coke especially with uniformity in the size of both and with a relatively high effective height.

* * *

Recent Observations on Sugarcane Starch and its Effect on Filtrability of Sugar. E. J. BUCHANAN. *S. African Sugar J.*, 1958, **42**, 32–47.—In experiments using a soluble starch mixed with a refined sugar to give 60°Bx solutions containing 1000 p.p.m. starch on Brix it was found that : the filtration rate varies inversely with the starch concentration; that a constant amount of the initial starch was removed from the solutions (52–53%), implying that the filtration rate varies inversely with the amount of starch removed; that no separation of amylopectin and amylose occured during filtration and that no or very little starch was retrograded; that viscosity increases with the amount of starch; that very little starch was absorbed on the filter aid with varying pH, the amount being unchanged by varying electrolyte concentrations; that the filtration rate increased with reduced pH, although the starch removal did not vary with pH changes. The addition of electrolytes caused an increase in the filtration rate due to the reduction of the "h" potential of the colloid. For an average Natal affined sugar containing 500 p.p.m. starch, the starch may reduce the filtration rate by about 15% compared with a pure sucrose solution.

* * *

Determination of Certain Qualities of Individual Cane Consignments. C. VAN DER POL and C. M. YOUNG. *S. African Sugar J.*, 1958, **42**, 49–55.—Tests were made on cane fibre determination by various methods of direct analysis. The methods used were found inadequate as alternatives to the direct analysis method already in use (drying the whole residue after water extraction in a high speed blender). Direct drying of the whole cane at 105°C took too long (4 hr) and it was difficult to obtain a constant dry weight owing to decomposition of certain substances in the cane and possibly to "case hardening" of the fibre particles; accurate determination of the Brix of the juice in the cane was also difficult. Expression of up to 70% of the juice by a hydraulic press followed by drying of the bagasse gave excellent results, but took longer than the standard method. Determination by making a Brix balance between the Brix of the juice in the cane and the Brix of the direct-analysis extract[1] is inaccurate, as the assumption that Brix of juice in cane = Brix of first expressed juice is insufficiently accurate. The approximately linear relationship between fibre % cane and volume of expressed juice is not sufficiently stable to be used for accurate fibre determination.

* * *

Moisture Absorbtion in Warehouse by Commercial Sugar. D. J. YANDE. *Proc. 14th Conv. Deccan Sugar Tech. Assoc.* (*India*), 1957, 12–14.—Bagged sugar in a store in 1955/56 absorbed water over its surface. Pol, sucrose, invert, ash and moisture content, safety factor and conductivity were not appreciably different for a sugar from another factory which was not affected. Moisture absorbtion is discussed generally and the views of other technologists solicited.

* * *

The Cell-Less Vacuum Filter Working in the Kopargaon Sahakari Sakhar Kharkhana Ltd., Kopargaon. S. R. KULKARNI. *Proc. 14th Conv. Deccan Sugar Tech. Assoc.* (*India*), 1957, 34–37.—An account is given of difficulties with a G.H.H. rotary vacuum filter installed at Kopargaon and tested during the past two seasons. The equipment was very subject to vacuum leakage during the first season but gave better results in the second after some modifications which are briefly mentioned.

* * *

Towards Minimization of Sugar Losses from cane to Crystal. B. L. MITTAL. *Proc. 14th Conv. Deccan Sugar Tech. Assoc.* (*India*), 1957, 94–100.—Losses in the sugar factory from cane transport to final molasses are reviewed under three classifications :

[1] *See I.S.J.*, 1958, **60**, 113.

losses by chemical and/or bio-chemical reaction, physical losses, and losses in final molasses. Recommendations are made for minimization of certain of the sources of loss.

* * *

Steam Generation and Steam Consumption. R. D. JOSHI and M. K. VAIDYA. *Proc. 14th Conv. Deccan Sugar Tech. Assoc. (India)*, 1957, 115–122.—Techniques for improvement of steam generation and usage efficiency are described with particular reference to economisers, flue-gas analysis and bagasse drying, and to measures described by SPENCER & MEADE[1]. The economies possible are calculated, with a note on the importance of retaining balanced steam production and consumption. Information is requested on the operation and efficiency of the Buckau R. Wolf evaporator and vapour bleeding at Pravaranagar factory.

* * *

A Step Towards Economy. L. CHHINA and A. A. KHOT. *Proc.* 14th *Conv. Deccan Sugar Tech. Assoc. (India)*, 1957, 179–181.—A heater installed between the final effect and condenser raises raw juice temperature from 70°F to 115°F, so saving steam, and in addition reduces the load on the condenser and injection water pump and improves the vacuum.

* * *

Corrosion—Causes and Control. J. F. WILKES. *Rpts. Hawaiian Sugar Tech., 16th Meeting*, 1957, 11–14. The nature, cause and treatment of various types of corrosion are reviewed.

* * *

Chemical Approach to Residual Fuel Oil Problems. R. L. PAINE. *Rpts. Hawaiian Sugar Tech., 16th Meeting*, 1957, 91–93.—Difficulties occurring with fuel oil storage and firing are discussed and remedies suggested.

* * *

"Rapi-Dorr" Clarifier at Hawaiian Commercial and Sugar Co. W. S. HAINES. *Rpts. Hawaiian Sugar Tech., 16th Meeting*, 1957, 98–102.—When the Paia mill clarification station was modernized a 22 ft "Rapi-Dorr" unit was installed in parallel with an 18 ft Dorr "Multifeed", these being fed in a ratio of 3 : 1 from a weir box. The "Rapi-Dorr" replaced two 18 ft 5-compartment Dorr clarifiers, and comparative data are tabulated for the 1956 and part-1957 seasons. The "Rapi-Dorr" and "Multifeed" clarifiers produced effluents of comparable quality when operated at the specification total feed rate, and the 1957 combination produced slightly better clarified juice at slightly higher flow rates and insoluble solids percentages than did the combination of three clarifiers used during the 1956 season.

* * *

Ash and Bagasse Handling at Ewa. E. F. FERGUSON. *Rpts. Hawaiian Sugar Tech., 16th Meeting*, 1957, 103–104.—Ash and bagasse handling improvements include a new prefabricated steel building of 900 tons capacity for bagasse storage; a hardwood flight dual-purpose conveyor for moving bagasse to and from storage; a 23 tons/hr hardwood flight elevator; a Hough "Payloader" for moving bagasse to the hopper feeding the elevator; and a "Mighty Mouse" tractor which operates in an area of only 5 ft headroom to move ashes into a semi-automatic skip hoist system.

* * *

Economics of Steam and Electric Generation Modernization. J. G. SIMONOFF. *Rpts. Hawaiian Sugar Tech., 16th Meeting*, 1957, 104–110.—The modernization of the steam and electric power generation equipment at Puunene mill since 1952 is described and the economics discussed and illustrated in the form of graphs.

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Koloa Sink-Float Rock Gap. V. VARGAS. *Rpts. Hawaiian Sugar Tech., 16th Meeting*, 1957, 110–112.—The water rock-gap at Koloa was replaced, with beneficial results, by a mud-bath using a mud of 20°Bé density, circulated by means of two propellers. The mud overflows from the bath and passes to a surge tank feeding a 100 h.p. 2500 g.p.m. pump piped to the header. For mud storage two 20 ft dia × 20 ft high steel tanks are used, one being made into a hydroseparator. The overflow is discarded while the more concentrated underflow goes back to the mud-bath as make-up.

* * *

Automatic Crusher Feed for Waialua Mill. E. S. P. SMITH and A. HONKE. *Rpts. Hawaiian Sugar Tech., 16th Meeting*, 1957, 113–115.—Possible methods of controlling cane carrier speed are discussed, and a description given of the system adopted at Waialua. This is basically a Ward Leonard variable speed control automatically varied by a magnetic amplifier which receives its control signals from the upper knife motor and from the cane blanket ahead of the crusher. The combination of signals was used instead of the knife motor signal alone because the latter was not adequate for complete automatic operation as the cane density would change several times per hour, even using the same variety. The grinding rate increased by 7–10 t.c.h. at top mill speed, so decreasing the grinding season by 7–10 days.

* * *

Instrumentation in the Hawaiian Sugar Industry. H. C. BURGESS. *Rpts. Hawaiian Sugar Tech., 16th Meeting*, 1957, 116–118.—Instrumentation and automatic control is generally discussed and the need for proper maintenance emphasized. A number of checks and precautions are briefly described which are to ensure proper operation of controllers.

* * *

Juice Straining. A. M. BLOOMFIELD. *Jamaican Assoc. Sugar Tech. J.*, 1956, **19**, 55–58.—Methods of removing bagacillo and sand from mill juice are reviewed and a description given of experience with a vibrating screen installed at Bybrook. While performance is not yet completely satisfactory, it is nevertheless considered that this equipment is the most successful for screening mill juices.

[1] Cane Sugar Handbook. 8th Edn. (Wiley, New York), 1945.

Changes in Composition of Beet Pulp as a Source of Technological Difficulties. K. DUSZCZYNSKA and A. WARCHALOWSKI. *Gaz. Cukr.*, 1957, **59**, 321–324.—Difficulties encountered during the second half of the 1956/57 campaign in the processing of frozen beet are discussed and full analytical results given. Decomposition of albumins in the frozen beet caused by anaerobes and of the pectins by aerobes led to an increase of the non-sugars in diffusion juice. Polysaccharide decomposition complexes in diffusion juice amounted to almost 350 g/hectalitre at one factory. Pectins were represented mainly by compounds of $>$ 5000 mol. wt., which were therefore little affected by CO_2 and consequently passed to crystallization.

* * *

Mycoflora of (Beet) Storage Piles. J. ORLOWSKA. *Gaz. Cukr.*, 1957, **59**, 343–346.—An illustrated description is given of the various fungi occurring at pH 4·5–6·7 at a temperature of 20–30°C and at 82–85% relative humidity.

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Through-Circulation Drying of Vegetable Materials. II. Sugar Beet. T. J. MITCHELL and C. S. POTTS. *J. Sci. Food Agric.*, 1958, **9**, 29–38.—The reactions which take place during beet drying and the advantages and disadvantages of the various types of dryers are discussed. The drying rate of single layers of cossettes in a through-circulation dryer varied noticeably with temperature and increased slightly with a fourfold increase of air velocity. Humidity changes were found to have little effect, while the drying rate was proportional to the total moisture content of the cossettes. A formula for the drying rate constant is given. The difference between actual and predicted drying time varied from —3·5% to +15·3%. Some caramelization took place only at 210 and 220°F after 80 min drying, and at 200°F after 2½ hr drying, the pieces affected having a moisture content of 4–5%.

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Some Ideas concerning the Technical Value of the Sugar Beet. J. DEDEK. *Paper presented to the 11th Tech. Conf., British Sugar Corp.*, 1958.—It is proposed that a survey be made of the qualities and properties of the sugar beet, with methods for their measurement and relative evaluation, which may act as criteria in deciding the value of the beet as a guide to breeders and agriculturalists, and also for comparison of manufacturing techniques.

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Nitrate Reduction by Thermophilic Bacteria in Sugar Beet Diffusion Systems. A. CARRUTHERS, P. J. GALLAGHER and J. F. T. OLDFIELD. *Paper presented to the 11th Tech. Conf., British Sugar Corp.*, 1958.—While no nitrite was found in beets, amounts of 2–45 p.p.m. occurred in factory raw juice. Diffusion of beets at a temperature high enough to suppress bacterial activity produced nitrite-free juice and the nitrite consequently arose from bacterial reduction of the nitrate present in the beets. This was proved by analysis of raw incubated with soil. Nitrite too was found to disappear and was converted to imidodisulphonic acid, nitrogen and bacterial protein. The organisms are believed to be two strains of *B. stearothermophilus*, the first reducing nitrate to nitrite and the second reducing the nitrite. Bacterial activity is greatly reduced by a temperature of 74–75°C and by addition of 0·01% of formaldehyde ; however, formaldehyde-resistant strains of the bacteria have been shown to develop. Nitrate, nitrite and lactic acid concentrations and pH have no effect on the bacterial action. In addition, nitrate and nitrite concentration did not obviously influence lactic acid production which was at the rate of approximately half the amount of sucrose destroyed.

* * *

Operation of the Rain-Am-Lech Factory during the 1957/58 Campaign[1]. L. KAYSER. *Paper presented to the 11th Tech. Conf., British Sugar Corp.*, 1958.—A number of difficulties were found in the first few weeks, as might be expected with a new factory, but thereafter the factory worked well. Adequate fresh water was available, except for a few weeks of drought. Beet reception was satisfactory and the pile ventilation system worked well. No trouble was experienced with beet transport to the factory and slicers. Sand catcher capacity had to be expanded, and some trouble occurred at first with the pulp dryer station, the main difficulty being in controlling furnace temperature from the flue-gas temperature. Clarification was good and the Sepa mud satisfactory. Much difficulty was caused by using untrained labour. Impurities in condensate occasionally meant that the boiler water treatment plant was inadequate. White sugar was produced from the start of the campaign. The sugar silos were finished late so that some of the sugar entering first of all became wet. A total of 234,000 tons of beet was worked, an average of 2,440 tons per day, and yielded 32,000 tons of white sugar. Diffusion loss was 0·21% on beet at a draught of 116% ; sludge loss was 0·05% and unknown losses 0·23% on beet. Coal consumption was 9·1% on beet and this is expected to be lowered to 7·4% in the future.

[1] Cf. *I.S.J.*, 1958, **60**, 145.

Instrumentation within the British Sugar Corporation. R. M. J. WITHERS. *Paper presented to the 11th Tech. Conf., British Sugar Corp.*, 1958.—Detailed descriptions are given of the instruments used in the Corporation for accurate and reliable measurement of the primary variables—liquid level, liquid flow, liquid temperature, vapour flow, liquid density and pH—discussing the reasons for the selection of the equipment chosen. Some of the newer techniques for measurement of weight, solids level, % sugar in solution, moisture content and % oxygen are described and aspects of increasing instrumentation of factories briefly discussed, as is the process control scheme at Wissington.

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Investigations into Pulp Dryer Performance. B. S. BROOKS, P. SCOTT and R. M. J. WITHERS. *Paper presented to the 11th Tech. Conf., British Sugar Corp.*, 1958.—The dryer installation at Spalding consists of three Büttner drums with induced-draught stoker-fired furnaces. The exhaust gases pass from the outfall to cyclones and the dried molasses-pulp discharges from the bottom of the outfall housing. During the 1957/58 campaign No. 1 dryer was operated as originally designed and under manual control. Its speed was increased from 1·51 r.p.m. to 2·45 r.p.m. In No. 2 dryer the gas temperature leaving the furnace was controlled by altering the speed of the stoker and the gas temperature at the dryer exit controlled by varying the pressed pulp feed scroll speed. Insulation was added to the hot end of the drum and the airseal at the drum to the outfall housing was modified to reduce air dilution. The speed was increased from 1·51 to 2·55 r.p.m. Drum No. 3 was controlled in the same way as No. 2 but had additional shelving added to flights along the length of the drum at the top and bottom. Arrangements were made for sampling the pulp at intervals along the drums and provision was made for temperature measurement by thermocouple. Dewpoints were measured with the Foxboro-Yoxall "Dewcel" instrument. The results are tabulated in great detail and illustrated with graphs. Leakage of air into the outfall housing appears to be of the order of 20% with a total dilution from all sources of the order of 60%. The pattern of drying in the drum is discussed and it is found that an appreciable proportion takes place in the outfall. Very appreciable radiation loss occurs, particularly at the furnace. The shelf modification in Dryer No. 3 improved pulp distribution. A drum longer than necessary is wasteful from the point of fabrication and housing cost, corrosion, and h.p. necessary to develop the required suction at the outfall.

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Construction of the Rain-am-Lech Factory. H. MATHEIS, P. BERGER and H. BOHN. *Zucker*, 1958, **11**, 27–38. **Equipment of the Rain Sugar Factory.** B. BRUKNER. *Ibid.*, 38–44.—An illustrated description is given of the layout of the buildings and machinery at the Rain-am-Lech factory of Süddeutsche Zucker A.G. previously described[1].

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Selection of Rational Type of Diffuser. M. A. BORKOVSKII. *Sakhar. Prom.*, 1958, (1), 14–18.—The R.T. rotary diffuser, B.M.A. and Buckau-Wolf tower diffusers, the Olier and D.d.S. diffusers are compared and their comparative economics considered. The Olier is considered the best technically, but as the differences are slight, the economics are the deciding factor, from which point of view the D.d.S. is considered the best.

* * *

Calculation of the Effective Capacity of a Clarifier for Continuous Predefecation. V. M. KATS. *Sakhar. Prom.*, 1958, (1), 31–33.—A formula for calculation of the effective volume of a continuous predefecator when the volume of the carbonatation juice is equal to that of the diffusion juice is given as :

$$V = 1{\cdot}42\ at$$

where V = effective capacity in cu.m., a = amount of diffusion juice per min, and t = time of predefecation. It is shown from theoretical considerations that the capacity need be only 42% greater than that of the standard apparatus instead of 100% more.

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Results of using an Imported Beet Piler at the Salivonkov Sugar Factory. V. A. NOVIKOV, N. M. KICHIGIN, KH. D. PECHENYI and V. I. VASIL'EV. *Sakhar. Prom.*, 1958, (1), 45–53.—One of two Silver beet pilers manufactured by U.C.M.A.S. of Tirlemont, Belgium, was put into operation in 1957. The truck is raised on a tilting platform so that the beet is tipped into a hopper. It is taken by belt conveyor at an angle of 47·5° to an 18 m piling conveyor, raised and lowered by winch, via a dirt and trash remover composed of 9 rollers. The dirt drops to either of two lateral conveyors extending beyond the sides of the piler. Steel brackets on the conveyor belt prevent the beet from slipping. The average unloading time, independent of truck load (2·5–4 tons) is 3 min 10 sec and the piler moves at 2–6 m per 4 min on caterpillar tracks. Average capacity was 65 tons/hr (60 tons/hr with one move) and a crew of 6 is needed, including 4 to open and close drop-boards and clear dirt and trash from the platform. Satisfactory results have been obtained and use of the machines in Soviet factories is advocated.

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Multi-Stage Braking for Automatic Beet Scales. F. M. KRIVOROTOV. *Sakhar. Prom.*, 1958, (1), 63–64.—To ensure even flow of beets to the automatic scales and thus prevent premature weighing when beet flow is uneven, a guide plate and baffle were installed in the chute.

I.S.J., 1958, 60, 145.

New Books and Bulletins

Proceedings of the 31st Annual Congress of the South African Sugar Technologists Association. 149pp; $8\frac{1}{2} \times 11$ in. (South African Sugar Technologists' Association, Mount Edgecombe, Natal). 1958. Price: 30s. 0d.

The 31st Annual Congress of the South African Technologists' Association was held in Durban during the 25th–29th March 1957, and the present volume is a record of that meeting. It includes the text of speeches made and a list of members and guests, and also includes information on the Association and its officers, past and present. Chemical laboratory reports, weather, and agricultural data are summarized. The bulk of the volume is occupied by the text of papers presented to the Congress, on factory and agricultural topics, and the last page carries a list of instuctions to authors.

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Memoria Correspondiente a los Años Azucareros 1953–54 a 1956–57. 443 + 236 pp; $6\frac{1}{4} \times 9\frac{1}{4}$ in. (Ministerio de Industrias y Trabajo, Montevideo, Uruguay.) 1957.

The Comisión Honoraria del Azúcar was brought into being by Government decree in 1952 to act as advisers on sugar industry matters and to administer the "basis for stabilization of the price of sugar". The first of the present two volumes is a survey of the work of the Commission, and gives the text of reports, correspondence, etc., as well as discussing the importation of raws for refining, the sugar beet and sugar cane industries, costs, cane payment, etc. A statistical section provided tables and graphs of production, imports, prices, consumption and distribution of sugar. The second volume is a record of the laws, decrees and resolutions affecting the Uruguay industry, and dating from 1940 to 1957.

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The Sugar Economies of India and the Far East. Ed. H. Ahlfeld. 37 pp; $8\frac{1}{4} + 11\frac{3}{4}$ in. (F. O. Licht K.G., P.O. Box 90, Ratzeburg, Germany). 1958.

This special edition from F. O. Licht is in two parts, the first containing a general survey of the sugar economy in the Far East, which discusses the great possible developments in that part of the world as a result of the increasing population and standard of living. Subsequent chapters refer to individual countries—India (by J. S. Mehta), Pakistan, Indonesia, the Philippines, Japan (by S. Nobunaga), Taiwan, Mainland China and Australia—while the remaining chapter deals briefly with the sugar economies of Fiji, New Zealand, Ceylon, Indo-China, Malaya, Thailand, Burma, Korea and Hong Kong.

The second part is called "Asian Sugar Statistics" and includes a number of tables, covering sugar balance, production, exports, imports, consumption and data for some of the individual countries.

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Die Zuckerwirtschaft der Französischen Union. (The Sugar Economy of the French Union.) In German. K. Rogge and W. Schubert. 92 pp; $5\frac{3}{4} \times 8\frac{1}{4}$ in. (Marktforschungsstelle Zucker e.V., Bonn, Am Hofgarten 8, Germany.) 1958. Price: DM 7.00.

This is another in the series of paper-backed reports[1] produced by the M.F.Z. and is divided into two main parts. The first covers beet sugar production in Metropolitan France with a table showing the location of the beet industry by départements. The production figures for 1937/38 and for the post-war years to 1957/58 are compared. The 1957/58 figure of 1,436,000 metric tons white value is lower than the peak of 1,519,000 tons in 1954/55 and below the 1953/54 figure, but compares favourably with the 1937/38 figure of 872,000 tons. Thus for sugar production France stands with Germany at the top of the member countries of the European Economic Community. The beet acreages for 1957/58 and 1958/59 are compared by départements and factory locations and capacities in 1955/56–1956/57 tabulated. The cane sugar industries of the French Antilles, Réunion and Madagascar are reviewed and the sugar balance and consumption of Metropolitan France and overseas possessions discussed separately. The second part covers the organization of the beet economy and of the sugar industry, the sugar marketing controls and price system with comparison of the French and West German prices. In an appendix are given the addresses of sugar industry organizations, and a list of factories with daily capacities and location numbers referring to a folding-map in a pocket on the inside back cover.

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Sugar Year Book 1957. 138 pp; $3\frac{1}{2} \times 5\frac{1}{4}$ in. (International Sugar Council, 28 Haymarket, London S.W.1. 1958. Price: 10s. 0d.

The latest edition of this volume of statistical information is still of the same size as formerly, but has lost the word "Pocket" from its title. New tables for Morocco and Turkey are included, but otherwise the booklet is the same as the previous edition, brought up to date. As such it is a most useful collection of data for anyone required to have imports and exports at his finger-tips for countries both signatory and non-signatory to the International Sugar Agreement.

[1] Cf. *I.S.J.*, 1957, **59**, 131.

LABORATORY METHODS AND CHEMICAL REPORTS

Marc Contents of Sugar Beet. K. VUKOV. *Növénytermelés*, 1956, **5**, 355–366; through *S.I.A.*, 1957, **19**, Abstr. 984.—A quick method for determining marc in beet comprises taking a sample of pulp from the beet by means of a segment rasp, drying the pulp and determining the total dry solids content, making an aqueous extract of the same pulp, and determining the soluble dry solids content by refractometer. The difference between the two solids contents represents the insoluble dry solids, i.e. the marc. The error of the method is ± 0·39%, largely owing to the deficiency of the refractometric measurement. A high correlation (0·79) was found between the hydrated marc volume (t ml/100 g) and the dry marc content (m g/100 g), the regression equation being $t = 2\,m$—3·5. There was only a slight correlation (0·41) between the resistance to cutting of the beet and the marc content, but the correlation of cutting resistance with crude fibre is 0·52. The workability of the beet is thus affected more by the composition of the marc than by the amount of marc.

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Nomograms for Viscosity of Sugar Solutions and Molasses. P. M. SILIN. *Sakhar. Prom.*, 1957, (12), 37–40.—Nomograms using a logarithmic scale show the viscosity of sugar solutions of 72% to 86% concentration at 30–80°C in intervals of 10°, based on I. N. KAGANOV's function:

$$\eta = Ae^{\frac{BN}{T}}$$

where η = sugar solution viscosity, T = absolute temperature, N = molar concentration of the sugar, A and B are constants. The molasses nomogram is based on the function $\eta = A.10^{\frac{B}{T}}$ and gives the viscosity of molasses of 72–87°Bx (refractometric without dilution) from 20 to 80°C.

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Refractometric Method of Determining Saturation Coefficients. I. E. SADOVOI. *Sakhar. Prom.*, 1958, (12), 55–57.—A saturated solution of unknown purity is saturated successively at two temperatures, e.g. 45° and 50°C, with pure sucrose of known moisture content, and the Brix determined refractometrically. From these two amounts the amount of sucrose dissolved between 45 and 50°C per part of water present (S_1) is calculated and the "saturation coefficent" (α) expressed as the ratio of this amount to that dissolved, per part of water, in a parallel experiment with a pure sucrose solution (S_0). The amount of sucrose which would dissolve at 45°C in the water present is calculated from α and data from the literature for pure solutions. The sucrose dissolving in saturated solutions between the original temperature and 45°C is calculated from the Brix values, and this amount is deducted from the amount above, so giving the sucrose content of the original saturated solution. From this and the Brix, the purity is calculated. An editorial note points out that with a temperature difference of only 5°C (50°–45°C), an error of 1% in the refractometric Brix reading is magnified to an 11% error in the coefficient, which can lead to an appreciable error in the puity value obtained.

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Determination of Colloidal Substances in Juices and Syrups. P. V. GOLOVIN, M. A. ABRAMOVA, A. A. GERASIMENKO and Z. B. SHAPOSHNIKOVA. *Sakhar. Prom.*, 1957, (12), 51–52.—A. V. DUMANSKII's method[1] of determing colloidal substances in juices and syrups has been found to give high results as a consequence of precipitation of lime salts with the colloids. In tests, the results of which are tabulated, the precipitated colloids were filtered through a glass filter and the sugar was removed with 15–20 ml rectified spirit (α–naphthol test for removal) and the residue dried to constant weight; the filtrate and washings were poured into a flask and the spirit removed, the lime salts then being determined complexometrically. The lime salts in the juice after precipitation were less than before, owing to precipitation of these with the colloids, the colloidal content of carbonatation juice treated with 1·3% CaO being that of normal 2nd carbonatation juice (treated with 2·75% CaO by wt.). The colloids in the former retained considerably more lime salts than those in the normal juice, and the possibility is suggested that lime salts are not only absorbed on the surface of the colloids but also connected by ionization with the organic acid radicals, so entering the ions of the colloids and coagulating under the effect of the spirit.

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Study of the Granulometry of Sugar Crystals in Massecuites. I and II. J. BAERTS and S. LANGE. *Rpt. Lab. J. Dedek* (Tirlemont), 1958, (4), 33, 24 pp; **III.** S. LANGE. *Ibid.*, (5), 11 pp.—(i) Synthetic massecuites were prepared by mixing pure saturated sugar solution with various fractions of a sieved sugar. Homogeneity was ensured by mixing in a slowly rotated test-tube in which a glass ball, travelling up and down the tube, displaced and mixed the crystals and syrup. Representative sampling of the mixture was obtained by means of a horizontal spiral of stainless steel wire, supported from the centre where the wire was bent vertically. The outer diameter was sufficient to go inside the tube, allowing free passage of crystals, and the interval between adjacent coils of the spiral also permitted passage of sugar. The spiral was agitated inside the tube, withdrawn, the vertical wire wiped clean and the sample displaced onto a graticuled glass slide by gentle rotation. The

[1] *Water-soluble Colloids in Food Products and their Importance in Technological Processes.* (Moscow, 1943.)

slide was then placed on a projector and an enlarged image cast onto sensitive paper which was developed. The number of crystals of each size in a composite massecuite could be determined and the proportion of sucrose in the massecuite calculated (a) by measurement of the relative volume and (b) by measuring the relative weights. For the former a cover glass was placed over the slide and held by its thickened ends at a fixed distance. Thus the volumes concerned were related to the easily measured surface areas; however, this proved insufficiently accurate and method (b) was adopted. Knowing average weights for crystal size fractions, the numbers of each fraction and the total weight of sample, the crystal percentage could be calculated and was 97–103% of the sugar present as determined from Brix measurement before and after warming to dissolve the crystals.

(ii) For massecuites where the unit weight of crystals of the various size fractions is unknown, it is necessary to relate the surface area to weight, and this was done by measuring sieved samples using 300 × magnification. A curve was produced, corresponding to the relationship $\log P = 1{\cdot}4808 \log S - 0{\cdot}719$, where P and S are the weight and surface of plane projection of the crystal in mg and sq. mm. respectively.

(iii) By projecting a sample of known weight onto a piece of white semi-transparent paper the outlines of the crystals could be drawn and then filled in with black ink. A photometric measurement of light transmitted indicated the percentage of surface blackened and hence the total surface of projection of the crystals. From the average surface (total divided by the number of crystals) and the data prepared above, the average weight of the crystals and so the total crystal weight was given. This provided a simple and rapid method for obtaining the percentage of crystal content by weight, and its accuracy was found to be about 1%.

* * *

Research in Hawaii. ANON. *Rpt. H.S.P.A. Expt Sta. Comm.*, 1957, 26–30.—

Colour in Sugars.—Electrophoresis led to the identification of certain organic impurities in raw sugar crystals. Two colour bands, yellow and brown, migrated in opposite directions; five coloured substances were resolved from the former, indicating the presence of naturally occurring plant pigments of flavonoid character, while the brown band contained carbohydrate degradation products and amino-acids, of which glutamic, aspartic acids and tryptophane were identified. A sugar grain camera is described and illustrated[1].

Crystallization rate.—Sugar crystallization rate was reduced by aspartic and glutamic acids (0·085% concentrations causing a 7–9% decrease), and by potassium and sodium chlorides, while calcium chloride increased the crystallization rate.

Cane Juice Analysis.—Cane juice of 65°Bx diluted with 20% water by volume was dialysed against water. Toluene was placed on top of the juice column to prevent microbial attack. All sugar, soluble salts and other low mol. wt. soluble materials were removed within 72 hr and considerable yellow colour with them. The residual black liquor was removed after 1 week and most of the water removed at 65°C under vacuum. The black liquid was filtered and a grey solid, mainly bagasse pith, removed. The residual water was removed in a vacuum desiccator, yielding about 5 g of black brittle solids from 100 g juice. Paper electrophoresis of the dried dialysate, re-dissolved in water showed reducing materials not corresponding to glucose and levulose compounds, giving ultraviolet fluorescence, and some amino-acids and proteins.

* * *

The Solubility of Sucrose. F. H. C. KELLY. *Sugar J.* (La.), 1958, **20**, (8), 14–15, 28–29.—The data available on sucrose solubility is discussed and data obtained by the author, using a refractometric technique, are compared with those of HERZFELD, of WISE and NICHOLSON[2], and TAYLOR[3]. The polarimetric and refractometric methods are considered limited in accuracy, and it is maintained that the basic solubility data must refer to a solution in equilibrum with solid-phase macro-size particles at the specified temperature. The results of TAYLOR conform most closely to the two types of formulae described, although these cover only a relatively narrow temperature range. It is pointed out that in the calculation of oversaturation (supersaturation—1) a difference of 0·27% in concentration of a saturated solution represents a possible error of 14% in the former figure for a solution of supersaturation coefficient 1·10.

* * *

Conditions Affecting the Quality of Clarified Liquors. I. Loading Tests. J. MLCHOVÀ. *Listy Cukr.*, 1958, **74**, 11–13.—The effect of heat was determined in laboratory tests on 60° Brix solutions of affined sugar added to thin juice, factory condenser water, undistilled and distilled water, lime water and to aqueous solutions of $CaCO_3$, MgO, $Ca(HCO_3)_2$, $Ca(HSO_3)_2$, $(NH_4)_2CO_3$ and $(NH_4)_2Fe(SO_4)_2$. Factory filtered clarified liquors were also tested. The colour, alkalinity, pH and conductivity of the solutions were determined before and after 3 hours heating on a boiling water-bath. The non-sugars had marked inhibiting effect, while the conductivity fluctuated moderately, indicating changes in the organic compounds present. The pH and titration alkalinity to phenolphthalein end-point decreased; the solution in lime water showed a colour increase of 500% while the colour of the solution in thin juice increased by 955%.

* * *

Drying out of Crystal Sugar in Sample Tins. H. MASKOVÁ. *Listy Cukr.*, 1958, **74**, 14.—Moisture loss in dampened refined sugar kept in tins for 3 months was at the daily rate of 0·2–1·8 mg per 100 g, while the loss was reduced by about half in sugar stored in glass flasks. Losses with fine crystals were 4 to 6 times greater than with coarse crystals, although the original moisture content was only about 30% higher.

[1] *See I.S.J.*, 1958, **60**, 139.
[2] *J. Chem. Soc.*, 1955, 2714; *I.S.J.*, 1956, **58**, 259, 329–332.
[3] *J. Chem. Soc.*, 1947, 1678, *I.S.J.*, 1948, **50**, 292–295.

BY-PRODUCTS

Molasses Fermentation, Continuous Fermentation, Alcoholic Fermentation of Blackstrap Molasses. W. BORZANI and E. AQUARONE. *J. Agric. Food Chem.*, 1957, **5**, 610–616; through *J. Sci. Food Agric. Abs.*, 1958, **9**, i 34.—Factors that influence the continuous alcoholic fermentation of blackstrap molasses, viz. sugar concentration of feed mash, feed rate, agitator speed and fermenter capacity were studied on a pilot plant scale. The sugar concentration and the fermentation-cycle time can be related by an equation, theoretically justified, if it is assumed that the sugar consumption has a reaction rate of –1. Agitation is probably the rate-determining factor. Penicillin increases the efficiency by preventing contamination. After 30 hr of fermentation at 25–26°C the penicillin concentration was 25–60% of the initial antibiotic concentration. Various concentrations were tried; addition of 1·0 unit per ml of penicillin gave good results; an increase in the alcohol yield (4·8–19·5%) and a reduction in the acid production (17·9–66·6%) were observed. *Leuconostoc* contamination was inhibited by 80 units per ml.

* * *

By-Products in Hawaii. ANON. *Rpt. H.S.P.A. Expt. Sta. Comm.*, 1957, 49–53.—*Cane Wax.*—Crude wax from the cane-cleaner effluent stream has poorer emulsifiability and emulsion stability than refined cane wax and would not replace the large volume hard waxes. Refining techniques for filter-cake wax are being studied. Crude hard wax is light-brown with a slightly burnt odour and m.p. of 80°C, giving an average empirical composition of $C_{26}H_{54}O$ (carbon 81·75%, hydrogen 13·89% and oxygen 4·36%). Fractionation with boiling acetonitrile or ethanol gave a soluble yellow wax of m.p. 80–81°C (45%), mainly wax alcohol and some ketone, and an insoluble brown wax of m.p. 79–80°C (55%), mainly ester. Saponification analysis indicates 3% hydrocarbons, 20% wax ketone, 40% wax alcohol (possibly higher) and 37% acids (possibly lower). Saponification with alkali hydroxide or alkali metal dissolved in alcohol gave a light tan unsaponifiable wax of m.p. 84°C, and a pale yellow wax acid of m.p. 84°C. Complete oxidation of the wax alcohols with potassium dichromate in acetic acid gives white wax of m.p. 86°C, yield 75–80%, soluble in hot acetonitrile, consisting mainly of wax acid. The green wax residue of m.p. 90–92°C, is composed of wax acid salts and a small amount of ester. A water soluble emulsifier for water in oil, prepared from wax alcohol, leaves thin, apparently continuous, films on the surface of a container of water as the solvent evaporates, demonstrating potentialites as a means of reducing evaporation from water surfaces. A flow diagram is given for preparation of several organic materials from filter-cake extracts. The unsaponifiable crude de-waxed filter-cake extract comprises 13·6% unsaponifiables, 86·4% acids, and 6·1% sterols, of which 21–22% was stigmasterol and 78–79% β-sitosterol. The preparation of sucrose ester detergents from de-waxed cane oil is discussed.

Ammoniated bagasse pith fodder.—Studies of bagasse pith ammoniation showed that increase of pressure, temperature, ammonia : pith ratio, and time of reaction increased the nitrogen content approximately linearly; that ammoniation of fresh mill pith (40–50% moisture) introduced more nitrogen than in the case of air- or oven-dried pith; that aqueous ammonia was less effective than anhydrous ammonia; that rates of heating and cooling are important. Pre-hydrolysis treatment of the pith with acid (1–2% on dry pith), preferably sulphuric or phosphoric, and subsequent ammoniation resulted in the introduction of much more nitrogen than could be accounted for as ammonium sulphate or phosphate. A pilot plant is described for ammoniation of 100–200 lb batches (dry weight) of bagasse pith. A ration for sheep of 25% ammoniated pith (one-third the total nitrogen in the mix) with 56% molasses was prepared but was not readily eaten. *Bagasse hardboard.*—The conversion of ammoniated pith into hardboard is to be tested. At a temperature of 300°F at 2000 p.s.i. and a nitrogen value >1·9%, a black product was obtained of 86 lb/cu. ft. density or 1800 lb per 1000 sq. ft. of ¾-in board. Water resistance of the board is not outstanding unless a small amount of resin is added. An organic binder (5% by weight) mixed with dried bagasse pith and pressed at 400°F and 500 p.s.i. for 3–6 min gave a block of about 33 lb/cu. ft. of excellent appearance and completely resistant to boiling water. The tensile strength of small blocks was 1000 p.s.i. and compressive strength 2500 p.s.i. One ton of raw materials costing $50 will produce about 1000 sq. ft. of ¾-in board.

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Bagasse Paper in China. A. J. STEIGER. *Sugar y Azúcar*, 1958, **53**, (1), 23–25.—Bagasse is passed through knives which chop it into pieces no longer than 3 cm ; dust is removed from the product which is digested by the magnesium sulphite process, using an SO_2 content of 3% in the liquor. The cellulose is grey and dirty but can be used for paper and board where this is not important. Alternatively it is treated with bleaching powder to give a whiter product.

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Biological and Technological Principles of Molasses Production and Quality. I. Technological Methods—How to Reduce Production and Improve Molasses Quality. A. MIRCEV and K. SANDERA. *Listy Cukr.*, 1958, **74**, 15–18. **II. Biological and Technological effects on Molasses Production.** M. DRACHOVSKÁ and K. SANDERA. *Ibid.*, 19–21.—Problems connected with molasses production and the relationship between beet quality and molasses properties are reviewed.

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Bagasse—Its Industrial Utilization. S. C. JAIN. *Indian Sugar*, 1957, **7**, 598–603.—The various uses of bagasse are reviewed with 4 references to the literature.

PATENTS

UNITED KINGDOM

Measurement of the Resistance of Sugar Juices. SOC. FRANÇAISE DE REGULATEURS UNIVERSELS ARCA, of Paris 15ème, France. **796,674.** 27th April, 1956; 18th June, 1958.—The resistance of the sugar liquor in a pan is measured using alternating current passing through carbon electrodes, the magnitude of the positive amplitudes being increased with respect to that of the negative amplitudes. This is done either by partly rectifying the A.C. by including in the circuit a resister shunted in parallel with a rectifier, or by inserting a D.C. generator in the circuit feeding the electrodes. In this way the electrodes are given a positive polarity with respect to the boiler metal and consequently do not attract scale. Thus the apparatus may be used for a much longer period without cleaning.

* * *

Purifying Sugar-containing Liquids. MAGNETRIT A.G., of Zürich, Switzerland. **798,881.** 18th July 1955; 30th July 1958.—Clarification of raw beet or cane juice is carried out with the aid of reactive magnesium carbonate ($MgCO_3,3H_2O$ or $MgCO_3,5H_2O$) which may be used in a number of ways. It may be added as a solid or in suspension to raw juice, or formed *in situ*; it may be produced by carbonatation of a juice to which a mixture of CaO and MgO has been added. It may be added to a limed juice to give $CaCO_3$ and $Mg(OH)_2$, or to a juice previously limed and carbonatated to pH 10·4–11·2; and excess $MgCO_3$ may be removed by liming and separation of the precipitate, followed by treatment with CO_2 or SO_2.

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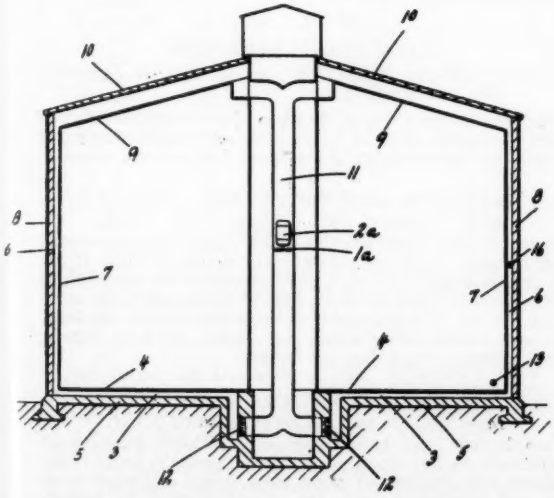
Bulk Sugar Silo. INGENIORSFIRMAN NILS WEIBULL A.B., of Malmö, Sweden. **799,413.** 16th February 1956; 6th August 1958.—The silo is provided with insulated outer walls 8 and roof 10 and with uninsulated walls 7 and ceiling 9 made of materials of good heat conductivity. Between the "inner" silo and outer surfaces is an air-sealed space 6. The part of space 6 at the top of the silo is connected with that part at the bottom by means of a vertical pipe 11 and air can be circulated by means of either a reversible fan 1*a* driven by motor 2*a*, or two fans operating in opposite directions. The air flow passes over heating elements 12 at the bottom branches of pipe 11 and so is warmed in its passage around the sugar and free air space above. A thermostat 13 in a corner of the sugar is connected with a control mechanism which alters the direction of the fan and hence of the flow of air, while another thermostat 16 in the air space 6 governs the amount of heating medium put into the heating element 12.



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Isolation of Dextran from Fermentation Products and its Degradation. COMMONWEALTH ENGINEERING CO. OF OHIO, of Dayton, Ohio, U.S.A. **800,288.** 27th December, 1956; 20th August, 1958.—A crude fermentation is treated with 15–30% of iso-propanol and held at room temperature for ½–1 hour. Dextran remains in solution while certain impurities are insolublised. These impurities are removed by filtration or centrifuging and the dextran recovered by increasing the iso-propanol concentration until it is precipitated. It may then be degraded by dissolving in water and treating with acid, followed by neutralization, decolorization, deionization, clarification and spray-drying. Alternatively, the decolorized, deionized, clarified solution may be treated with iso-propanol to precipitate the dextran and this dehydrated with acetone.

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Push-Type Centrifuges. ESCHER WYSS A. G., of Zurich, Switzerland. **800,319.** 27th May, 1957; 27th August, 1958.—*See* U.S.P. 2,828,021[1].

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Beet Harvester. O. A. SILK, of Leamington Spa, Warwickshire. **800,790.** 7th March, 1957; 3rd September, 1958.

* * *

UNITED STATES

Heat Transmission Indicating System for Sugar Solution. H. A. DITMAR JANSSE, assr. DITMAR ZONEN N.V., of Naarden, Holland. **2,838,934.** 8th September, 1955; 17th June, 1958.—See U.K. Patent 784,458.[2]

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Beet Topper. L. W. SCHMIDT, of Rio Vista, California, U.S.A. **2,840,173.** 9th April, 1957; 24th June, 1958.

[1] *I.S.J.*, 1958, **60**, 243.
[2] *I.S.J.*, 1958, **60**, 84.

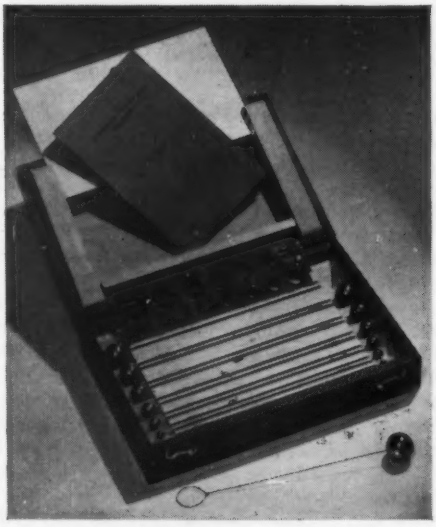
Copies of Specifications of United Kingdom Patents can be obtained on application to H.M. Patent Office, 25 Southampton Buildings, London, W.C.2. (price 2s each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. (price 25 cents each).

TRADE NOTICES

Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

The Koch Viscometer. M. G. Reade, Prospect House, Heath St., London N.W. 3.

The Koch viscometer is designed for use with viscous fluids and pastes and yields results in absolute units which are reproducible within 1%. The equipment is completely portable and consists of a graded series of fourteen stainless steel balls each attached to a fine stainless steel wire carrying two markers



spaced 10 cm apart. A reading is obtained by allowing a ball to sink in the fluid being tested and measuring the time required to sink between the markers. Reference to tables in the handbook provided then gives the apparent viscosity at each rate of shear (one for each ball used). The equipment was designed for use with chocolate but is applicable to all dense fluids such as syrups, molasses, etc.

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Hygrometers, Etc. Shaw Moisture Meters, 31 Market St., Bradford, Yorks.

A new hygrometer with an immediate response, stable characteristics and provision for easy checking and standardization uses a detector which consists of a capacitor with a hygroscopic dielectric, only a few microns thick, covered by a 24-ct gold electrode. This is contained in a small fine-wire gauze protector and is connected to an indicator or remote recorder. It has a wide range of uses, including measurement of atmospheric humidity and sugar moisture. A meter has a range of 0–100% water and, also working on the dielectric principle, measures the water content of a 1000 c.c. sample of material including beet pulp, for which purpose it is used by the British Sugar Corporation Ltd.

Weatherill Loading Shovels. F. E. Weatherill Ltd., Tewin Rd., Welwyn Garden City, Herts.

The Model 12H loading shovel illustrated is powered by a 44 or 58 h.p. Fordson Major Diesel engine, has a 40° scoop crowd angle, a low carrying position for excellent visibility and no spillage. It can load into hoppers up to 12 ft high and can be provided with scoops of $\frac{3}{4}$ to 2 cu. yd. capacity, each

in two widths. All scoops cover the wheel track ensuring a clean-swept path for the front wheels. A torque converter and power steering are optional extras. Other loaders include the 14H front-wheel drive machine of similar specification to the 12H and the S type described earlier[1].

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PUBLICATIONS RECEIVED.

LECHLER SPRAY NOZZLES. Ascog Ltd., 44 Theobalds Rd., London W.C.1.

Illustrations are given of the types of sprays with a range of nozzles available, some of which have been supplied to sugar factories and refineries for use in sugar dust recovery boxes.

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SHAFT-MOUNTED SPEED REDUCERS. Link-belt Company, Prudential Plaza, Chicago 1, Ill., U.S.A.

A new 24-page book describes a new range of shaft-mounted speed reducers which are of two types—single reduction (5 : 1) and double reduction (15 : 1). Six sizes of the first range up to 50 h.p. capacity while the seven sizes of the second range up to 40 h.p. A list of applications includes beet slicers, clarifiers, conveyors, cranes, rotary dryers and coolers, elevators, mixers, pumps, screens, skip hoists and stokers.

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MIST ELIMINATORS, DEMISTERS, SEPARATORS. Knit-Mesh Ltd., 36 Victoria Street, London S.W.1.

Two leaflets have been issued on KnitMesh entrainment separators[2]; the first describes the material and the design range available, with illustrations of the types, design and engineering data, and installation, while the second contains the specifications and prices.

[1] *I.S.J.*, 1957, **59**, 230.
[2] *I.S.J.*, 1958, **60**, 213.

Licht's Estimates of European Beet Sugar Production[1]

(metric tons—raw value)

	1958/59	1957/58	1956/57
Germany, West	1,705,000*	1,585,140*	1,157,883
Germany East	800,000	852,222	486,667
Austria	285,000	284,231	215,288
Belgium	390,000	388,423	326,841
Bulgaria.....	160,000	130,000	118,890
Czechoslovakia	800,000	879,790	657,575
Denmark	375,000	366,667	344,679
Eire	145,000	122,387	98,497
Finland	27,500	27,227	32,212
France	1,700,000	1,572,512	1,402,222
Holland	500,000	396,854	357,462
Hungary	286,000	275,656	266,524
Italy	1,011,000	867,000	971,750
Jugoslavia	196,200	260,840	165,216
Poland	1,178,000	1,178,442	862,000
Roumania	225,000	205,942	167,890
Spain	491,000	332,601	400,449
Sweden	257,000	324,000	281,816
Switzerland	34,000	37,603	33,770
Turkey	366,000	356,111	307,286
U.K.	640,000	625,616	780,962
U.S.S.R.	5,850,000	4,900,000	4,778,000
Total Europe	17,421,700	15,969,264	14,213,879

* Included sugar from imported beet.

Venezuela Exports[2]

Destination	1957 (metric tons)	1956
Italy	3,256	3,391
Austria	12	—
France	25,047	—
French Morocco	6,122	3,718
Holland	9,678	4,647
Switzerland	1,354	5,018
Greece	12,039	10,236
Germany	202	—
Belgium	6,377	—
U.K.	9,274	—
Curaçao.....	598	135
Colombia	20,179	—
U.S.A.	1,352	—
Libya	2,024	—
Malta	2,697	—
Israel	5,182	—
Roumania	—	4,200
Other countries	—	9
	105,393	31,354

Jamaican 1958 Sugar Crop.[3]—The 1958 sugar crop has now been concluded and amounts to 332,975 tons—about 61,300 tons less than originally estimated.

* * *

New Factory for Durban.[4]—A £600,000 factory is being built at Rossburgh, Durban, to produced refined, factory-packed sugar and a wide range of syrups for the South African market. It is a joint venture by Hulett's South African Refineries Ltd. and Corn Products Refining Co. Inc., of New York, who have formed a new company, Refined Sugars and Syrups S.A. (Pty.) Ltd. The sugar will be marketed in cardboard packets and will undergo new extra processing to ensure maintenance of a uniform high quality. New plant on order is completely automatic and includes electronic control equipment. It is hoped that the factory will be in production in early 1959.

BREVITIES

Bookers Engineering Expansion.—Bookers Engineering Holdings Ltd., a member of the Booker Group, has purchased 90% of the share capital of Sigmund Pumps Ltd., of Gateshead, Co. Durham, makers of centrifugal pumps for a wide variety of industries.

* * *

Cuban Sugar Tax.[5]—The Cuban House of Representatives has passed the Senate-approved Bill establishing a tax of ten cents on every 250 lb bag of sugar produced in coming crops. The proceeds will be used to cover expenses of maintaining public order in view of the revolutionary activities. The tax will be maintained as long as circumstances make it necessary.

* * *

New Sugar Book.—A new book, "Basic Calculations for the Cane Sugar Factory" has been published by Booker Brothers McConnell & Co. Ltd. It has been written by J. EISNER, Technical Adviser to Bookers, who has much experience in the cane sugar industry and has been one of those responsible for the remarkable modernization and expansion of British Guiana's factories since the war. It is available from the International Sugar Journal Ltd. Sugar Books Dept. at a cost of 7s 6d ($1.00 U.S.). The new book will be reviewed in our pages shortly.

* * *

Particle Size Distribution of Icing Sugar.—Messrs. Kek Ltd., who are the largest manufacturers of pin mills in the U.K., have asked us to point out that the particle size distribution of the sugar sample prepared in a pin mill, referred to in their article by Hill & Muller[6], is not, in their opinion, representative of the best performance of modern pulverizers of this type. The authors of the article have confirmed that the sugar sample was, in fact, prepared using an old-type pin mill.

* * *

Principles of Sugar Technology.—Elsevier Publishing Company, publishers of the first volume of Honig's valuable reference book, announce that the second volume will be available shortly, probably in December. The second volume covers the crystallization of sucrose as the pure chemical and commercial material, and includes chapters by the leading experts in this field. A third volume, covering evaporation, centrifugalling, grading and classification of sugars and molasses, will be published in due course.

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U.S. Domestic Supply Quotas, 1958.—The Hawaii and Virgin Islands quotas were reduced in September by a total of 74,449 tons. This was redistributed to the U.S. domestic beet and cane suppliers and to Cuba. Following this, on October 2nd, the U.S. Dept. of Agriculture increase the Supply Quota by 100,000 tons, and a similar increase on 14th October brought the total quota to 9,200,000 short tons. Individual quotas, as adjusted, are as follows :

Raw sugar value	*Short tons*	*Long tons*
Domestic beet	2,342,488	2,091,507
Mainland cane	720,805	643,576
Hawaii	700,000	625,000
Puerto Rico	815,000	727,679
Virgin Islands	6,100	5,446
Philippines.....	980,000	875,000
Cuba	3,387,582	3,024,627
Other foreign countries*.....	248,025	221,451
	9,200,000	8,214,286
* Of which :		
Peru	55,588	49,632
Dominican Republic	86,831	77,528
Mexico	66,266	59,166

[1] F. O. LICHT, *International Sugar Report*, 1958, **90**, (9), 1—8.
[2] F. O. LICHT, *International Sugar Report*, 1958, **90**, (9), 12.
[3] *Public Ledger*, 18th October, 1958.
[4] *S. African Sugar J.*, 1958, **42**, 769.
[5] *Public Ledger*, 18th October, 1958.
[6] *I.S.J.*, 1958, **60**, 128–132.

BREVITIES

Argentine Beet Factory Tender[1].—It is reported that tenders for the installation of a beet sugar factory in the Province of Buenos Aires have been called for by the Provincial Government.

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New Roumanian Sugar Factory.[2]—According to reports from East German sources, the largest and most modern sugar factory in Roumania has now been put into operation at Livezi. The plant was delivered and erected by East German firms and has a daily processing capacity of 2000 tons of beets.

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Japanese Refinery for the U.A.R.[3]—The Shin-Mitsubishi Heavy Industries Company of Japan will deliver a complete sugar refinery to the United Arab Republic. The price will be over $8·7 million f.o.b. and the plant is to be put in operation by January 1952. Its daily capacity will be 4000 tons, but its location is not yet known.

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Dominican Republic—Germany Trade Agreement.[4]—Under the terms of a trade agreement signed recently in Bonn, the Federal German Republic agrees to take a total of 40,000 tons of sugar from the Dominican Republic during each of the years March–February 1958–59 and 1959–60. Of this, 30,000 tons are for internal consumption and 10,000 tons are for resale to other Western European countries not regular buyers of sugar of this origin.

Lebanon Refinery Destroyed[5].—A sugar refinery at Abdé on the northern border of Lebanon is reported to have been destroyed by rebels.

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New Jugoslav Factory[6].—A new factory with a capacity of 20,000 tons of white sugar, is to be built at Bitolj in South Macedonia, at a cost of 2100 million dinars.

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Haiti Sugar for Export[7].—With the opening of a new sugar mill at Aux Cayes, it is anticipated that some 35,000 metric tons will be available for export this year, of which about 7000 tons can fill Haiti's U.S. quota, leaving 28,000 tons approximately for the World Market.

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Sugar Cane in Israel.[8]—The Israeli Ministry of Agriculture has announced that tests on cultivation of sugar cane in the district of Hula and in the Jordan valley have been successful and that cultivation is to be started in the coming season. This year's sugar production amounted to about 12,000 tons of refined beet sugar ; the Israeli Government hopes to close the gap between production and consumption by cultivation of sugar cane.

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New Greek Factory.[9]—The Danish firm of TOPSE has been retained by the Greek Government to study and advise on the tenders submitted for the proposed sugar factory and advise on the tenders submitted for the proposed sugar factory near Larissa[10]. It is rumoured that West German firms are likely to be favoured in the TOPSE report, which coincides with the fact that Greek-German economic negotiations are in progress in Bonn, where German financial assistance for various projects, including the establishment of a sugar factory, is being discussed.

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Sir J. L. Hulett & Sons Ltd. 1957/58 Report.—Production of the Hulett group included 332,386 tons of sugar in South Africa (34·6% of total production) and 4761 tons in Rhodesia. Darnall, Amatikulu and Felixton mills produced 246,011 tons of sugar from 2,351,956 tons of cane. Direct delivery of cane by road has considerably reduced crushing time lost through interruptions of cane supply. Empangeni mill crushed 698,769 tons of cane to give 76,376 tons of sugar and an expansion scheme is in progress which will raise production capacity to upwards of 100,000 tons of sugar per annum. The cost is estimated at approximately £600,000 and it is hoped to be completed by mid–1959. Refinery output was 272,097 tons—more than 21,000 tons over the previous season. A large expension programme has been started and £1,500,000 has been spent, including the installation of bulk loading facilities. A new carbonatation station is to be completed early in 1959. The Company's expansion of the Triangle estate in Southern Rhodesia[11] and its entry into Swaziland[12] are recorded.

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Sugar in Nigeria.[13]—A small pilot scheme is being started in Ilorin province to test the commercial possibilities of large-scale production of sugar under irrigation.

Stock Exchange Quotations

London Stocks (*at 20th October* 1958)

	CLOSING MIDDLE
Anglo-Ceylon (5s)	15/1½
Antigua Sugar Factory (£1)	21/–
Booker Bros. (10s)	22/9
British Sugar Corp. (Ltd. (£1)	17/3
Caroni Ord. (2s)	4/3
Caroni 6% Cum. Pref. (£1)	17/6
Distillers Co. Ltd. (6s. 8d units)	27/3
Gledhow Chaka's Kraal (£1)	63/9
Hulett & Sons (£1)	83/–
Jamaica Sugar Estates Ltd. (5s units)	6/6
Leach's Argentine (10s units)	8/6
Reynolds Bros. (£1)	51/–
St. Kitts (London) Ltd. (£1)	52/6
Ste. Madeleine (Ord.) (£1)	28/9
Sena Sugar Estates (10s)	27/–
Tate & Lyle (£1)	69/9
Tate & Lyle Investments Ltd. (5s)	13/10½
Trinidad Sugar (5s stock units)	12/–
United Molasses (10s stock units)	33/6
West Indies Sugar Co. Ltd. (£1)	28/–

New York Stocks (*at 18th October* 1958)

	CLOSING MIDDLE $
American Crystal ($10)	39¼
Amer. Sugar Ref. Co. ($100)	33¾
Central Aguirre ($5)	20⅝
Cuban American ($10)	30¼
Great Western Sugar	28⅜
South P.R. Sugar	27⅝
United Fruit Co.	44⅛
West Indies Sugar Corp. ($1)	58

[1] C. Czarnikow Ltd., *Sugar Review*, 1958, (367), 140.
[2] F. O. LICHT, *International Sugar Report*, 1958, **90**, (Supp. 18), 8.
[3] F. O. LICHT, *International Sugar Report*, 1958, **90**, (Supp. 20), 13.
[4] F. O. LICHT, *International Sugar Report*, 1958, **90**, (5), 11.
[5] F. O. LICHT, *International Sugar Report*, 1958, **90**, (7), 10.
[6] F. O. LICHT, *International Sugar Report*, 1958, **90**, (7), 2.
[7] C. Czarnikow, Ltd., *Sugar Review*, 1958, (364), 128.
[8] F. O. LICHT, *International Sugar Report*, 1958, **90**, (Supp. 20), 14.
[9] F. O. LICHT, *International Sugar Report*, 1958, **90**, (Supp. 20), 9.
[10] *I.S.J.*, 1957. **59**, 232 ; 1958, **60**, 27.
[11] *I.S.J.*, 1958, **60**, 218.
[12] *I.S.J.*, 1958, **60**, 154.
[13] *Overseas Review* (Barclays D.C. & O.), October 1958, p. 67.